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PREFACE

The Office of Radiation Programs (ORP) of the Environmental Protection Agency carries out a national program designed to evaluate public health impact from ionizing and nonionizing radiation, and to promote development of controls necessary to protect the public health and the environment. This report provides the technical information necessary for ORP to evaluate the environmental aspects concerning the transportation and disposal of low-level radioactive solid wastes generated by light-water-cooled nuclear power plants. Furthermore, ORPs current estimates of the quantity and radionuclide composition of low-level radioactive wastes which will shipped offsite for burial from a 1000 MWe LWR operating at 80 % capacity are presented. This information is also being used by ORP in the development of environmental radiation protection criteria and generally applicable environmental standards for low-level radioactive waste managment practices.

David S. Smith
Director
Technology Assessment Division (AW-459)

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Abstract

A 1975 study by the U.S. Environmental Protection Agency (EPA) which considered operating data from light-water-cooled nuclear power plants through 1974 resulted in projected volumes of waste considerably greater than that which was being used at the time by the Atomic Energy Commission (now the Nuclear Regulatory Commission) in environmental impact statements. A current study by the Nuclear Regulatory Commission (NRC) resulted in estimated volumes of waste which are in relative agreement with the 1975 EPA study. Another recent study by the Atomic Industrial Forum (AIF) concluded that the volume of waste from an LWR will continue to increase over the first ten years of life and then level off at a value approximately twice that calculated by the NRC or the EPA.

In consideration of the wide disparity of data bases and conflicting conclusions, this study will update the previous EPA study in an attempt to substantiate either the NRC study or the AIF study. In addition, this study will also provide a break down of projected annual volumes by type of waste, i.e., demineralizer resins and filter sludge, evaporator bottoms, and contaminated trash, and also identify the relative composition of the wastes by major nuclides. These latter results will be compared with similar results from the NRC study and a recent study prepared by Dames & Moore for the New York State Energy Research and Development Authority.

Introduction

This report is the result of a study conducted by the Office of Radiation Programs of the United States Environmental Protection Agency (EPA). This study investigated the volume and radioactivity of solid wastes being shipped for burial from light-water-cooled nuclear power plants (LWRs), and the relative composition of these wastes with respect to major radionuclides.

The results of this study will be used by the EPA in (1) its review of the environmental impact in nuclear power plants, (2) for improvement in predictive models, and (3) to provide additional data for use in EPA's program to develop environmental radiation protection criteria for radioactive waste management and environmental standards for low-level radioactive waste disposal.

Purpose

In an attempt to stabilize the current controversy over the question of the quantity of solid waste, and activity, the average reference LWR produces in a year the EPA undertook an independent study to analyze available information from nuclear power plant operating reports. An EPA study reported in 1975 (Ma-75) looked at the average quantities of waste reported as being shipped for burial and concluded that the average annual volume for a BWR was 35,000 cubic feet ($990m^3$) and for a PWR 21,000 cubic feet ($595m^3$). A study by the NRC (Be-77) reported in January of 1977 also concluded that the average annual volume of waste from a BWR was 35,000 cubic feet ($990m^3$) but for a PWR was only 15,500 cubic feet ($440m^3$). A more comprehensive study by NUS (Mu-76) for the Atomic Industrial Forum has reported estimates for BWRs of 55,000 cubic feet per year ($1560m^3/yr$) and for PWRs a volume of 40,000 cubic feet per year ($1130m^3/yr$). These values are summarized in Table 1 along with estimates of the radioactivity contained within these wastes by the NRC.

Instead of trying to pinpoint a specific value to typify an average annual waste volume for both BWRs and PWRs, we decided to evaluate the data in two ways. First we assumed that the reported volumes were strictly a function of plant housekeeping activities and radwaste management activities and independent of plant size, i.e., the reported values would be typical of plants of all sizes. Second, we assumed that the reported data were primarily a function of plant size and power generation. In actuality we feel that the true case is somewhere between these two cases and that the results of our analysis would then define a lower and an upper boundary about the true conditions.

In order to simplify the study we considered only those plants which have been operating more than one year and have an electrical

rating of more than 400 MWe. We did not include the first year if the plant operated for less than 6 months of that year. If the first year of operation was between six and eleven months the data was prorated to a full year. Plants with units of different size were also excluded if one of the units was less than 500 MWe. The actual annual data were then prorated to a 3400 MWt reference plant with an 80 percent plant capacity factor (PCF) using the actual gross thermal power generated during the year. The actual and prorated data for BWRs is given in Table 2, and for PWRs in Table 3. Hence further the actual data will be referred to as the lower limit and the data prorated to 3400 MWt and 80% PCF will be referred to as the upper limit. These data were then tabulated in terms of the number of years of operation, and averages calculated for each year of operation. See Tables 4 through 11. This procedure resulted in four sets of average values, each with an upper and lower limit, to be analyzed for significant statistical correlation with respect to the number of years of operation. These values are summarized in Table 12 for BWRs and Table 13 for PWRs. The upper and lower limits for each data set were then plotted on linear, semi-log and full log paper, a simple regression analysis performed with the resultant equation of best fit calculated along with the correlation coefficient. The equations and their correlation coefficients are also shown in Tables 12 and 13 Table 14 below shows the minimum value of r, the correlation coefficient, required to show significant correlation between the dependent and independent variables (CR69).

The analysis performed using the method of least squares shows a trend toward increased volumes of waste and increased activity, as the plants operate longer and longer. Of course, as with every rule there is an exception. In this case the exception is the upper limit of the volume of waste from PWRs. Each of the four sets of data will be discussed separately to evaluate the significance of the data. It should be pointed out ahead of time that while in some cases the correlation coefficients are much higher than needed to show significant correlation they do not necessarily tell the whole story. Obviously we do not expect volumes and activities to continue to increase at their previous rate. For one thing, there is a finite limit to the rate at which solid waste handling systems can process these wastes not to mention the financial burden which utilities are willing to accept. Therefore, our conclusions are based as much on intuitive practicality as on the analytical results of the analysis.

Source of Data

The data used in this report were taken directly from the semi-annual or annual operating reports or the radioactive effluent reports published by the utility responsible for the operation of the plant.

BWR Volume

Volumes of waste from BWRs is based on the average values shown in Tables 4 and 5. Each analysis, linear, exponential and power, shown in Figures 1, 2 and 3, respectively, resulted in correlation coefficients well above the minimum value to establish significant correlation. The average values analyzed, the equations of best fit and the correlation coefficients are shown in Table 12. What this analytical analysis fails to fully recognize is the apparent leveling off in the last three years of the data for the lower limit. While these most recent years are by no means conclusive, based on currently available information, the average annual volume of waste from these plants should run between 1000 to 2000 cubic meters. This is in basic agreement with the NUS estimate of 55,000ft^3/yr (1560m^3/yr), and slightly higher than previously estimated by the EPA or NRC.

BWR Activity

The activity of the waste from BWRs is based on the average values shown in Tables 6 and 7. The analysis performed on these data linear, exponential and power, as shown in Figures 4, 5 and 6, respectively, has also shown significant correlation to the number of years of operation. The average values analyzed, the equations of best fit and the correlation coefficients are also shown in Table 12. In the first five years of operation there has been a tremendous increase in the radioactivity associated with the solid wastes shipped from BWRs. As with the volume of waste, the analyses again fails to fully recognize the apparent leveling off over the last three years. In lieu of including data for 1976, which is not yet fully available, we feel that a reasonable approximation to use at this time is a range of 3000 to 7000 Ci/yr. Therefore, the NRC estimate of 4100 Ci/yr may be low but is definitely within an acceptable range.

PWR Volume

The volumes of waste from PWRs is based on the averages shown in Tables 8 and 9. The analytical analyses of these data; linear, exponential and power as shown in Figures 7, 8 and 9, respectively, did not result in any significant correlation with respect to the number of years of operation. The average values analyzed, the equations of best fit and the correlation coefficients are shown in Table 13. By visual inspection of Figures 7,8 and 9, it appears that volumes of 200 to 500 cubic meters could be expected. These estimates are slightly lower than the NRC estimate of 15,500ft^3/yr (440m^3/yr) and significantly lower than the NUS estimate of 40,000ft^3/yr (1130m^3/yr).

PWR Activity

The activity of the waste from PWRs is based on the average values shown in Tables 10 and 11. While the correlation coefficients obtained in these analyses are decidedly better than for the volume of waste from PWRs, they generally fail to meet the minimum requirement to show significant correlation. The results of linear, exponential and power analyses of these data are shown in Figures 10, 11, and 12, respectively. The average values, equations of best fit and correlation coefficients are shown in Table 13. Furthermore, the same problem arises here as with the BWR data; the data from the most recent years falls below that which is predicted by the analytical analysis, or in other words appears to be leveling off. Again, by visual inspection of the data we estimate annual activities of solid waste to average between 500 to 1500 curies as compared to the NRC estimate of 1900 curies.

Summary

Table 15 summarizes the results of this analysis and compares those results to the previous EPA study, the NRC study and the NUS study.

Major Radionuclides Found in Solid Radioactive Waste

Prompted by the NRC study mentioned previously and as part of the review of a study by Dames and Moore (Da-76) we expanded our investigation into solid radioactive waste from LWRs to cover the subject of the major contributing radionuclides in this waste. The plants used in the analysis in the first half of this report have only reported the volume and activity of their solid waste by type of waste for the last few years. In addition, this part of the study was not limited to plant greater than 500 MWe, but used all available data. Therefore, the values presented here on the volume and gross activity can not in any way be compared to the previously reported results. The two types of waste investigated are defined in Regulatory Guide 1.21 as Category A, filter sludges, spent resins, evaporator bottoms, etc.; and Category B, dry compressible waste, contaminated equipment, etc. Data was compiled from operating reports in which the solid waste data has been reported according to Reg. Guide 1.21. Available data covers the years 1974, 1975 and 1976. Not all reports for 1976 are available but we used what we had. The data used in this analysis, on a plant by plant year by year basis is detailed in Tables 16 through 25. Weighted averages were calculated for each of the three years, for Category A and B, for both PWRs and BWRs, see Tables 26 and 27. The cumulative averages, or combined averages of the most predominant isotopes, are shown in Table 28.

Table 28 shows the average percent by nuclide for the two categories of waste for PWRs and BWRs. Also shown is the percent of the total PWR waste, by volume and activity, which was found to be Category A and Category B, and the total BWR waste, by volume and activity, which was found to be of each category. For both types of plants filter sludges, spent resins and evaporator bottoms, constitute approximately 55% of the total waste volume and more than 95% of the activity whereas compressible waste and contaminated equipment constitute approximately 45% of the total waste and less than 5% of the total activity.

The results reported by NRC did not include the isotopic composition of dry compressible wastes but compared the composition of filter sludge and spent resin vs. evaporator bottoms. Their results are repeated here only as a comparison to the results of our study. See Table 29. It should be noted here that the source of the NRC data were the plant operating reports for Nine Mile Point Unit 1, 1974 and 1975, for the BWR data and H. B. Robinson, January to June 1975, for the PWR data.

The Dames and Moore report does not draw any conclusions as to the average composition of wastes from typical plants but it does report the composition of samples taken at four plants in New York State in 1976. The plants were, Nine Mile Point, FitzPatrick, Indian Point, and Ginna. The results of their analysis of these samples for Nine

Mile Point and Ginna are reproduced here in Table 30, for comparison to our analysis of the data.

Whether these percentages change during the life of the plant we do not know. Additional studies in this area will be performed from time to time and our results published.

Conclusions

The analyses we have performed are by no means conclusive. The estimates we have presented are in basic agreement with other studies and we hope add some stabilizing influence to the confusing question of how much waste at what level of activity. Obviously, we have admitted in our analysis that even though in some cases significant correlation does exist between the quantities investigated and the number of years of operation there are just not enough years of experience to draw definite conclusions. EPA will continue to monitor the data from operating reactors and report its findings on appropriate occasions.

Comparison of Previous Studies

	EPA-1975	NUS-1976	NRC-1977
Volume (m^3/yr)			
BWR	990	1560	990
PWR	595	1130	440
Activity (Curies/yr)			
BWR	N.C.	N.C.	4100
PWR	N.C.	N.C.	1900

N.C. - Not Calculated

Table 1

Plant - BWRs	yr	Actual Quantities Shipped		Power Generation		Quantities Shipped prorated to 3400 MW_t and 80 % PCF	
		m^3	Ci	Actual MWD_t	Prorated to 3400 MW_t and 80 % PCF	m^3	Ci
Browns Ferry	74[1]	261	70.9	6.08+5	1.63	372	101
Brunswick	75	411	6.96	2.33+5	3.55[2]	1460	25
Cooper	74	379	17.2	2.87+5	3.17	1200	55
	75	290	266.	2.31+5	4.30	1250	1140
Dresden 2 & 3	70	372[4]	(Ki-74) 9.4[4]	1.20+4	[4]	-	-
	71	558	(Ki-74) 49.2	4.63+5	4.28[5]	1190	105
	72	1000	119	1.05+6	1.89[5]	945	112
	73[14]	2200	134	1.28+6	2.32[6]	Excluded due to one unit < 500MWe	
All Units	74[14]	2190	(Nu-77) 5050	9.65+5	3.09[6]		
	75[14]	5850	7340	6.40+5	4.65[6]		
Duane Arnold	74	321	61.4	1.87+5	4.43[2]	1420	270
	75	262	79.0	3.09+5	3.21	841	254
FitzPatrick	74	0[13]	0[13]	0	0[13]	13	13
	75	510	132.	2.84+5	3.50	1780	462
Hatch	74	128[13]	8.3[13]	1.01+4	32.8[7]	13	13
	75	583	271.	4.07+5	2.44	1420	660
Millstone	70	0[13]	(Ki-74) 0[13]	1.20+4	20.7[8]	13	13
	71	208	(Ki-74) 95.5	4.63+5	2.14	445	204
	72	261	432.	4.04+5	2.46	642	1060
	73	351	2370.	2.48+5	4.00	1400	9480
	74	838	257	4.65+5	2.13	1780	547
	75	1780	2580	5.02+5	1.98	3520	5110

BWR Annual Volume and Activity Shipped & Prorated to 3400 MW_t and 80 % Capacity

Table 2

Plant - BWRs	yr	Actual Quantities Shipped		Power Generation		Quantities Shipped prorated to 3400 MW_t and 80 % PCF	
		m^3	Ci	Actual MWD_t	Prorated to 3400 MW_t and 80 % PCF	m^3	Ci
Monticello	70	0^{13} (Ki-74)	0^{13}	0^9	-	13	13
	71	309 (Ki-74)	17.6	1.79+5	5.55	1710	98
	72	178	88.2	4.54+5	2.19	390	193
	73	211	393	4.12+5	2.41	509	947
	74	268	2480	3.45+5	2.88	772	7140
	75	380	5430	3.70+5	2.68	1020	14600
Nine Mile Point	69	0^{13} (Ki-74)	0^{13}	1.23+4	26.9^7	13	13
	70	87 (Ki-74)	3.7	2.60+5	3.82	332	14
	71	366 (Ki-74)	201	4.14+5	2.40	878	482
	72	427	265	4.17+5	2.38	1020	631
	73	545	1010	4.57+5	2.17	1180	2190
	74	452	1930	4.26+5	2.33	1050	4500
	75	489	3260	4.03+5	2.46	1200	8020
Oyster Creek	69	0	0	4.89+4	13.3^{10}	0	0
	70	218	3.0	4.42+5	2.25	490	7
	71	292	5.0	4.87+5	2.04	596	10
	72	435	1300	5.41+5	1.83	796	2380
	73	832	2890	4.53+5	2.19	1820	6330
	74	1210	1570	4.64+5	2.14	2590	3360
	75	990	2810	4.09+5	2.43	2400	6830
Peach Bottom	73	30.1^{13}	0.3^{13}	0	$-^9$	13	13
	74	397	58.0	5.11+5	2.75	773	113
	75	582	217	1.39+6	1.43	416	165

BWR Annual Volume and Activity Shipped & Prorated to 3400 MW_t and 80 % Capacity

Table 2 (continued)

Plant - BWRs	yr	Actual Quantities Shipped		Power Generation		Quantities Shipped prorated to 3400 MW_t and 80 % PCF	
		m	Ci	Actual MWD_t	Prorated to 3400 MW_t and 80 % PCF	m	Ci
Pilgrim	72	67.5	19.	1.11+5	5.22[11]	352	99
	73	210	567	5.22+5	1.90	399	1080
	74	406	1460	2.50+5	3.97	1610	5796
	75	456	3800	3.38+5	2.94	1340	11200
Quad Cities	71	60 (Ki-74)	1	4.12+1[9]	-	13	13
	72	1070	9	5.21+5	1.91[12]	1170	9.6
	73	1010	294	1.18+6	1.68[5]	848	247
	74	831	735	1.09+6	1.82[5]	756	670
	75	1400	2410	9.64+5	2.06[5]	1440	2480
Vermont Yankee	72	126	18	6.16+4	13.4[2]	1690	241
	73	186	24	2.53+5	3.92	729	94
	74	198	108	3.42+5	2.90	574	313
	75	308	225	4.69+5	2.12	653	477

1 Due to the fire in 1975 data for this year was not considered
2 Based on 10 months, 80 % PCF at 3400 MW_t
3 Based on 11 months, 80 % PCF at 3400 MW_t
4 Dresden 2 took 2½ years to become commercial, and since power generated in 1970 was small, data for 1970 was not considered to be typical and therefore not used
5 Based on two units at 3400MW_t and 80 % PCF
6 Based on three units at 3400 MW_t and 80 % PCF
7 Based on 4 months, 80 % PCF at 3400 MW_t
8 Based on 3 months, 80 % PCF at 3400 MW_t
9 Low power testing - not taken as the first year

BWR Annual Volume and Activity Shipped & Prorated to 3400 MW_t and 80 % Capacity

Table 2 (continued)

[10] Based on 8 months, 80 % PCF, at 3400 MW_t

[11] Based on 7 months, 80 % PCF, at 3400 MW_t

[12] Neither unit achieved commercial operation until 1972 therefore 1972 was taken as equivalent to one 3400 MW_t unit at 80 % PCF

[13] Data for a given year was not condidered as the first year if the unit operated less than six months of the year

[14] Not used due to the complexity involved in evaluating three units with one unit < 500 MWe

BWR Annual Volume and Activity Shipped & Prorated to 3400 MW_t and 80 % Capacity

Table 2 (continued)

Plant - PWRs	yr	Actual Quantities Shipped		Power Generation		Quantities Shipped prorated to 3400 MW_t and 80 % PCF	
		m^3	Ci	Actual MWD_t	Prorated to 3400 MW_t and 80 % PCF	m^3	Ci
Arkansas One	74	0.	0.	8.29+4	4.99 [1]	20	20
	75	0.	0.	6.42+5	1.55	0.	0.
Calvert Cliffs	74	0.	0.	1.60+0	6.2+4 [2]	20	20
	75	0.	0.	5.84+5	1.70	0.	0.
Cook	75	172	.537	6.08+5	1.63	280	1
Fort Calhoun	73	45.4	.02	8.54+4	4.84 [1]	20	20
	74	323	10.	3.16+5	3.14	1010	31
	75	537	56.1	2.80+5	3.55	1910	199
Ginna	69	0.	0.	6.41+3	25.8 [3]	20	20
	70	51.4	5	2.85+5	3.48	177	17
	71	701	47	3.54+5	2.81	1970	132
	72	366	1410	3.21+5	3.09	1130	4360
	73	198	599	4.48+5	2.21	438	1320
	74	275	614	2.80+5	3.55	976	2180
	75	458	138	4.04+5	2.46	1130	339
Haddam Neck	67	0.	0.	7.07+4	7.02 [4]	0.	0.
	68	11.7	.1	3.96+5	2.51	29	.3
	69	83.3	51	4.81+5	2.06	172	105
	70	58.6	316	4.75+5	2.09	122	660
	71	104	274	5.59+5	1.78	185	488
	72	188	4770	5.74+5	1.73	325	8250
	73	159	571	2.91+5	3.41	542	1950
	74	204	942	5.90+5	1.68	342	1580
	75	624	1320	5.58+5	1.78	1110	2350

PWR Annual Volume and Activity Shipped & Prorated to 3400 MW_t and 80 % Capacity

Table 3

Plant - PWRs	yr	Actual Quantities Shipped		Power Generation		Quantities Shipped prorated to 3400 MW_t and 80 % PCF	
				Actual	Prorated to 3400 MW_t and 80 % PCF		
		m^3	Ci	MWD_t		m^3	Ci
Indian Point	72	191	157	1.12+5	5	-	-
	73	411	208	6.13+4	5	-	-
	74	445	61.9	2.44+5	5	-	-
	75	622	2000	6.85+5	5	-	-
Kewaunee	74	0.	0.	2.75+5	3.22[6]	0.	0.
	75	15.9	2.12	4.51+5	2.20	35.0	5.0
Maine Yankee	72	0.	0.	6.00+4	4.14[2]	20	20
	73	67.0	3.24	4.51+5	2.20	147	7.0
	74	159	530	4.81+5	2.06	328	1090
	75	231	1480	6.12+5	1.62	374	2400
Millstone	75	0.	0.	2.66+4	9.33[2]	20	20
Oconee	73	263	23.3	3.11+5	2.93[7]	841	74
	74	571	219	7.07+5	3.74[8]	916	351
	75	1420	1680	1.95+6	1.53[9]	724	857
Palisades	71	0.	0.	3.33+1	19,879. [10]	0.	0.
	72	9.63	1.85	2.46+5	4.04	39	7.0
	73	63.0	28.6	3.25+5	3.06	193	88
	74	234	26.6	1.65+4	5.02	1170	134
	75	801	210	3.71+5	2.67	2140	561
Point Beach	70	0.	0.	2.63+4	6.29 [3]	20	20
	71	76.4	4.0	4.17+5	3.97[12]	303	16
	72	194	214	4.15+5	4.78[13]	554	612
	73	295	1830	7.68+5	2.59[13]	383	2370

PWR Annual Volume and Activity Shipped & Prorated to 3400 MW_t and 80 % Capacity
Table 3 (continued)

Plant - PWRs	yr	Actual Quantities Shipped		Power Generation		Quantities Shipped prorated to 3400 MW_t and 80 % PCF	
				Actual	Prorated to 3400 MW_t and 80 % PCF		
		m^3	Ci	MWD_t		m^3	Ci
Point Beach (con't)	74	132	2120	8.48+5	2.34[13]	154	2480
	75	408	8230	8.72+5	2.28[13]	465	9400
Prairie Island	73	0.	0.	5.33+3	15.5 [14]	20	20
	74	136	76.1	2.19+5	4.53[15]	616	344
	75	150	34.7	9.38+5	2.12[13]	159	36.7
Rancho Seco	74	0.	0.	3.94+4	8.40[16]	20	20
	75	.011	.115	5.50+4	18.1	.02	2.0
Robinson	70	0.	0.	2.65+3	125. [16]	20	20
	71	24.2	NR	3.27+5	3.04	74	NR
	72	70.6	4.85	6.47+5	1.53	108	7.0
	73	292	96.7	5.08+5	1.95	569	189
	74	353	197	6.48+5	1.53	540	301
	75	356	1340	5.66+5	1.75	623	2340
San Onofre	67	0.	0.	4.93+4	11.7 [17]	0.	0.
	68	10.8	2.0	1.69+5	5.88	63.5	11.8
	69	40.0	8.0	3.29+5	3.02	121	24.2
	70	41.3	11.0	3.83+5	2.59	107	28.5
	71	22.9	2.0	4.15+5	2.39	54.7	4.78
	72	107	7.97	3.56+5	2.79	299	22.2
	73	113	381	2.93+5	3.39	383	1290
	74	68.3	230	4.06+5	2.45	167	564
	75	79.6	26.0	4.17+5	2.38	189	61.9

PWR Annual Volume and Activity Shipped & Prorated to 3400 MW_t and 80 % Capacity

Table 3 (continued)

Plant - PWRs	yr	Actual Quantities Shipped		Power Generation		Quantities Shipped prorated to 3400 MW_t and 80 % PCF	
				Actual	Prorated to 3400 MW_t and 80 % PCF		
		m^3	Ci	MWD_t		m^3	Ci
Surry	72	160	1.9-4	5.33+4	9.32[4]	2980	.004
	73	365	1.59	9.46+5	1.92[18]	382	1.7
	74	1250	50.6	4.60+5	4.32[13]	2700	109
	75	9210	2640	1.21+6	1.64[13]	21	21
Three Mile Island	74	200	6.06	3.26+5	1.78[17]	356	10.8
	75	458	258	7.34+5	1.35	618	348
Turkey Point	72	0.	0.	1.74+4	16.9 [2]	20	20
	73	233	3.98	6.43+5	2.45[19]	360	6.1
	74	449	44.7	1.06+6	1.87[13]	419	41.7
	75	889	104	1.16+6	1.71[13]	759	88.9
Zion	73	416	.159	1.14+5	5.08[15]	3170	1.0
	74	1620	4.65	7.03+5	2.82[13]	2280	6.5
	75	1580	15.4	1.37+6	1.45[13]	1150	11.2

1 Based on 5 months, 80 % PCF and 3400 MW_t
2 Based on 3 months, 80 % PCF and 3400 MW_t
3 Based on 2 months, 80 % PCF and 3400 MW_t
4 Based on 6 months, 80 % PCF and 3400 MW_t
5 Data not used due to complexity of evaluating units of different size which report combined data
6 Based on 10 months, 80 % PCF and 3400 MW_t
7 Based on 11 months of operation at 3400 MW_t and 80 % PCF (9 months of Unit 1 and 2 months of Unit 2 compared to single unit 3400 MW_t power plant due to minimal operation of unit 2)

PWR Annual Volume and Activity Shipped & Prorated to 3400 MW_t and 80 % Capacity

Table 3 (continued)

8 Based on 2 years 4 months of operation compared to three 3400 MW_t units at 80 % capacity
9 Compared to three 3400 MW_t units at 80 % capacity
10 Based on 8 months, 80 % PCF at 3400 MW_t
11 Based on 1 months operation at 3400 MW_t and 80 % PCF; plant shutdown Jan - Sept and Nov - Dec
12 Based on 1 year 8 months of operation compared to two 3400 MW_t units at 80 % capacity
13 Compared to two 3400 MW_t units at 80 % capacity
14 Based on 1 month, 80 % PCF at 3400 MW_t
15 Based on 1 year operation of one 3400 MW_t unit at 80 % PCF
16 Based on 4 months, 80 % PCF at 3400 MW_t
17 Based on 7 months, 80 % PCF at 3400 MW_t
18 Based on 1 year 10 months of operation compared to two 3400 MW_t units at 80 % capacity
19 Based on 1 year 7 months of operation compared to two 3400 MW_t units at 80 % capacity
20 Data for this year was not considered as the first year since the unit operated less than one year
21 Data for Surry in 1975 was not used. Plant personnel indicated the unusally large volume and activity shipped from the site was the result of some form of operational problem but refused to discuss details with us.

PWR Annual Volume and Activity Shipped & Prorated t0 3400 MW_t and 80 % Capacity
Table 3 (continued)

Plant - BWRs	Year of Operation							
	1 st*	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
Browns Ferry	228							
Brunswick	493							
Cooper	413	290						
Dresden	279	500						
Duane Arnold	385	262						
FitzPatrick	510							
Hatch	583							
Millstone	208	261	351	838	1780			
Monticello	309	178	211	268	380			
Nine Mile Point	87	366	427	545	452	489		
Oyster Creek	0	218	292	435	832	1210	990	
Peach Bottom	281	291						
Pilgrim	115	210	406	456				
Quad Cities	611	505	415	700				
Vermont Yankee	151	186	198	308				
Average m^3/yr	310	297	328	507	861	850	990	

* First year prorated to full year based on the actual number of months of operation

BWR Actual Volume Shipped per Unit - m^3/yr

Table 4

Plant - BWRs	Year of Operation							
	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
Browns Ferry	372							
Brunswick	1460							
Cooper	1200	1250						
Dresden	1190	945						
Duane Arnold	1420	841						
FitzPatrick	1780							
Hatch	1420							
Millstone	445	642	1400	1780	3520			
Monticello	1710	390	509	772	1020			
Nine Mile Point	332	878	1020	1180	1050	1200		
Oyster Creek	0	490	596	796	1820	2590	2400	
Peach Bottom	773	416						
Pilgrim	352	399	1610	1340				
Quad Cities	1170	848	756	1440				
Vermont Yankee	1690	729	574	653				
Average m^3/yr	1020	711	923	1140	1850	1900	2400	

BWR Annual Volume Shipped per Unit - m^3/yr
Prorated to 3400 MW_t and 80 % PCF
Table 5

Plant - BWRs	Year of Operation							
	1 st*	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
Browns Ferry	62							
Brunswick	8							
Cooper	19	226						
Dresden	25	60						
Duane Arnold	74	79						
FitzPatrick	132							
Hatch	271							
Millstone	95	432	2370	257	2580			
Monticello	18	88	393	2480	5430			
Nine Mile Point	4	201	265	1010	1930	3260		
Oyster Creek	0	3	5	1300	2890	1570	2810	
Peach Bottom	41	108						
Pilgrim	32	567	1460	3800				
Quad Cities	5	147	368	1210				
Vermont Yankee	22	24	108	225				
Average Ci/yr	54	176	710	1470	3210	2420	2810	

* First year prorated to full year based on the actual number of months of operation

BWR Actual Activity Shipped per Unit - Ci/yr

Table 6

Plant - BWRs	Year of Operation							
	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
Browns Ferry	101							
Brunswick	25							
Coo	55	1140						
Dresden	105	112						
Duane Arnold	270	254						
FitzPatrick	462							
Hatch	660							
Millstone	204	1060	9480	547	5110			
Monticello	98	193	947	7140	14600			
Nine Mile Point	14	482	631	2190	4500	8020		
Oyster Creek	0	7	10	2380	6330	3360	6830	
Peach Bottom	113	165						
Pilgrim	99	1080	5800	11200				
Quad Cities	10	247	670	2480				
Vermont Yankee	241	94	313	477				
Average Ci/yr	164	439	2550	3770	7630	5690	6830	

BWR Annual Activity Shipped per Unit - Ci/yr
Prorated to 3400 MW_t and 80 % PCF

Table 7

Plant - PWRs	Year of Operation								
	1 st*	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th
Arkansas One	0								
Calvert Cliffs	0								
Cook	172								
Fort Calhoun	323	537							
Ginna	51.4	701	366	198	275	458			
Haddam Neck	0	11.7	83.3	58.6	104	188	159	204	624
Kewaunee	0	15.9							
Maine Yankee	67	159	231						
Oconee	287	245	473						
Palisades	0	9.6	63	234	801				
Point Baech	76	116	148	66	204				
Prairie Island	136	75							
Rancho Seco	0.01								
Robinson	24.2	70.6	292	353	356				
San Onofre	0	10.8	40	41.3	22.9	107	113	68	80
Surry	320	199	625						
Three Mile Island	480	458							
Turkey Point	147	224	444						
Zion	624	810	790						
Average m^3/yr	142	243	323	158	294	251	136	136	352

* First year prorated to full year based on the actual number of months of operation

PWR Actual Volume Shipped per Unit - m^3/yr

Table 8

Plant - PWRs	Year of Operation								
	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th
Arkansas One	0								
Calvert Cliffs	0								
Cook	280								
Fort Calhoun	1010	1910							
Ginna	177	1970	1130	438	976	1130			
Haddam Neck	0	29	172	122	185	325	542	342	1110
Kewaunee	0	35							
Maine Yankee	147	328	374						
Oconee	841	916	724						
Palisades	0	39	193	1170	2140				
Point Beach	303	554	383	154	465				
Prairie Island	616	159							
Rancho Seco	0.2								
Robinson	74	108	569	540	623				
San Onofre	0	63.5	121	107	54.7	299	383	167	189
Surry	2980	382	2700						
Three Mile Island	356	618							
Turkey Point	360	419	759						
Zion	3170	2280	1150						
Average m^3/yr	543	654	752	421	740	585	462	254	650

PWR Annual Volume Shipped per Unit - m^3/yr
Prorated to 3400 MW_t and 80 % PCF
Table 9

Plant - PWRs	Year of Operation								
	1 st*	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th
Arkansas One	0								
Calvert Cliffs	0								
Cook	0.5								
Fort Calhoun	10	56.1							
Ginna	5	47	1410	599	614	138			
Haddam Neck	0	0.1	51	316	274	4770	571	942	1320
Kewaunee	0	2.1							
Maine Yankee	3.2	530	1480						
Oconee	25.3	93.8	560						
Palisades	0	1.8	28.6	26.6	210				
Point Beach	4	128	915	1060	4120				
Prairie Island	76.1	17.3							
Rancho Seco	0.1								
Robinson	NR	4.8	96.7	197	1340				
San Onofre	0	2	8	11	2	8	38.1	230	26
Surry	.0004	0.87	25.3						
Three Mile Island	10.4	258							
Turkey Point	2.5	22.3	52						
Zion	0.2	2.3	7.7						
Average Ci/yr	7.6	77.8	421	368	1090	1640	304	586	623

* First year prorated to full year based on the actual number of months of operation

PWR Actual Activity Shipped per Unit - Ci/yr

Table 10

Plant - PWRs	Year of Operation								
	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th
Arkansas One	0								
Calvert Cliffs 0	0								
Cook	1								
Fort Calhoun	31	199							
Ginna	17	132	4360	1320	2180	339			
Haddam Neck	0	0.3	105	660	488	8250	1950	1580	2350
Kewaunee	0	5							
Maine Yankee	7	1090	2400						
Oconee	74	351	857						
Palisades	0	7	88	134	561				
Point Beach	16	612	2370	2480	9400				
Prairie Island	344	36.7							
Rancho Seco	2								
Robinson	NR	7	189	301	2340				
San Onofre	0	11.8	24.2	28.5	4.8	22.2	1290	.564	61.9
Surry	0.004	1.7	109						
Three Mile Island	10.8	348							
Turkey Point	6.1	41.7	88.9						
Zion	1	6.5	11.2						
Average Ci/yr	28.3	190	964	820	2500	2870	1620	1070	1210

PWR Annual Activity Shipped per Unit - Ci/yr
Prorated to 3400 MW_t and 80 % PCF

Table 11

BWR - Average Values

Years of Operation	Annual Volume - m^3 Lower Limit	Annual Volume - m^3 Upper Limit	Annual Activity - Ci Lower Limit	Annual Activity - Ci Upper Limit
1	310	1020	54	164
2	297	711	176	439
3	328	923	710	2550
4	507	1140	1470	3770
5	861	1850	3210	7630
6	850	1900	2420	5690
7	990	2400	2810	6830

Type of Regression Analysis	Annual Volume - m^3 Lower Limit	Annual Volume - m^3 Upper Limit	Annual Activity - Ci Lower Limit	Annual Activity - Ci Upper Limit
Linear	$y=131t+67$ $r=.9436$	$y=266t+357$ $r=.9155$	$y=545t-629$ $r=.9148$	$y=1270t-1220$ $r=.9190$
Exponential	$y=207e^{.233t}$ $r=.9464$	$y=618e^{.187t}$ $r=.9019$	$y=56e^{.664t}$ $r=.9171$	$y=178e^{.622t}$ $r=.8997$
Power	$y=230t^{.681}$ $r=.8768$	$y=702t^{.509}$ $r=.7799$	$y=53t^{2.23}$ $r=.9764$	$y=164t^{2.11}$ $r=.9677$

Table 12

PWR - Average Values

Years of Operation	Annual Volume - m^3 Lower Limit	Annual Volume - m^3 Upper Limit	Annual Avtivity - Ci Lower Limit	Annual Avtivity - Ci Upper Limit
1	142	543	7.6	28.3
2	243	654	77.8	190
3	323	752	421	964
4	158	421	368	820
5	294	740	1090	2500
6	251	585	1640	2870
7	136	462	304	1620
8	136	254	586	1070
9	352	650	623	1210

Type of Regression Analysis	Annual Volume - m^3 Lower Limit	Annual Volume - m^3 Upper Limit	Annual Activity - Ci Lower Limit	Annual Activity - Ci Upper Limit
Linear	$y=3.82t+207$ $r=.1219$	$y=-19.8t+661$ $r=-.3347$	$y=83.7t+150$ $r=.4459$	$y=179t+358$ $r=.5143$
Exponential	$y=202e^{.0098t}$ $r=.0683$	$y=676e^{-.0461t}$ $r=-.3678$	$y=38.5e^{.409t}$ $r=.4506$	$y=113e^{.375t}$ $r=.7062$
Power	$y=187t^{.0814}$ $r=.1492$	$y=658t^{-.1428}$ $r=-.2997$	$y=19.1t^{1.93}$ $r=.5592$	$y=59.8t^{1.765}$ $r=.8735$

Table 13

Minimum Value of the Correlation Coefficient, r, to Show Significance at the 95% Probability Level

Degrees of Fredom	Significance Level $\alpha = .05$
1	.9877
2	.9000
3	.8050
4	.7290
5	.6690
6	.6210
7	.5820
8	.5490
9	.5210
10	.4970

Table 14

Estimated Volumes and Activities of
Solid Waste from LWRs

	EPA-1977	NRC-1977	NUS-1976	EPA-1975
Volume (m^3/yr)				
BWR	1000-2000	990	1560	990
PWR	200-500	440	1130	595
Activity (Curies/yr)				
BWR	3000-7000	4100	-	-
PWR	500-1500	1900	-	-

Table 15

CATEGORY A

PLANT HADDAM NECK YEAR 1975 VOLUME: JAN - JUN 11.4 m^3
JUL - DEC 7.6 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	195.	88.7	109.	10.
Co-60	25.	11.3	926.	85.
Cs-134			{54.	{5.
Cs-137				
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	220.	100.	1089.	100.

Table 16-a

CATEGORY A

PLANT INDIAN POINT YEAR 1975 VOLUME: JAN - JUN _____ m^3
JUL - DEC 321. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58			279.7	22.2
Co-60			48.	3.81
Cs-134			359.1	28.5
Cs-137			545.6	43.3
Fe-59				
I-131				
Mn-54			27.1	2.15
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL			1260.	99.96

Table 16-b

CATEGORY A

PLANT MAINE YANKEE YEAR 1975 VOLUME: JAN - JUN 119.6 m^3
JUL - DEC 25.9 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	273.4	20.	20.2	20.
Co-60	95.7	7.	7.	7.
Cs-134	382.8	28.	28.2	28.
Cs-137	615.2	45.	45.4	45.
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	1367.	100.	100.8	100.

Table 16-c

CATEGORY A

PLANT RANCHO SECO YEAR 1975 VOLUME: JAN - JUN 0.011 m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	.1	85.		
Co-60	.01	10.		
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54	.005	5.		
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	.115	100.		

Table 16-d

CATEGORY A

PLANT ROBINSON YEAR 1975 VOLUME: JAN - JUN _____ m^3
JUL - DEC 119. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57			.06	.2
Co-58			10.36	26.
Co-60			10.37	26.1
Cs-134			6.73	16.9
Cs-137			9.2	23.1
Fe-59				
I-131			.05	.1
Mn-54			1.17	2.9
Nb-95			.04	.1
Nb-97			.97	2.4
Sb-124			.52	1.3
Sb-125				
Other			.36	.9
TOTAL	322.*		39.8	100.

* No isotopic analysis given

Table 16-e

CATEGORY A

PLANT FORT CALHOUN YEAR 1976 VOLUME: JAN - JUN 168 m^3
JUL - DEC 235 m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	10.1	57	7.3	13
Co-60				
Cs-134	2.1	12.	20.2	36.
Cs-137	4.6	26.	25.3	45.
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other	.9	5.	3.4	6.
TOTAL	17.8	100.	56.2	100.

Table 17-a

CATEGORY A

PLANT HADDAM NECK YEAR 1976 VOLUME: JAN - JUN 70.82 m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	60.2	10.		
Co-60	481.6	80.		
Cs-134				
Cs-137	30.1	5.		
Fe-59				
I-131				
Mn-54	30.1	5.		
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	602.	100.		

Table 17-b

CATEGORY A

PLANT INDIAN POINT YEAR 1976 VOLUME: JAN - JUN 280. m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58				
Co-60				
Cs-134	89.9	22.7		
Cs-137	144.5	36.5		
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other*	161.6	40.8		
TOTAL	396.	100.		

* Mn-54, Co-58, Co-60

CATEGORY A

PLANT KEWAUNEE YEAR 1976 VOLUME: JAN - JUN 3.39 m^3
JUL - DEC _____ m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	.025	65.7		
Co-60				
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other	.01	34.3		
TOTAL	.035	100.		

Table 17-d

CATEGORY A

PLANT MAINE YANKEE YEAR 1976 VOLUME: JAN - JUN 58. m^3
JUL - DEC ____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	44.7	9.		
Co-60	89.1	18.		
Cs-134	139.2	28.		
Cs-137	223.7	45.		
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	497.	100.		

Table 17-e

CATEGORY A

PLANT MILLSTONE 2 YEAR 1976 VOLUME: JAN - JUN 201. m^3
JUL - DEC 78.9 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	.13	14.	.76	85.
Co-60	.01	.9	.03	3.
Cs-134	.01	1.	.02	2.5
Cs-137	.13	14.	.02	2.
Fe-59			.02	2.
I-131	.62	68.	.02	2.5
Mn-54	.02	2.	.03	3.
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	.92	100.	.89	100.

Table 17-f

CATEGORY A

PLANT PRAIRIE ISLAND YEAR 1976 VOLUME: JAN - JUN 79.3 m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	22.4	64.		
Co-60	7.7	22.		
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54	3.2	9.		
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other	1.8	5.		
TOTAL	35.	100.		

Table 17-g

CATEGORY A

PLANT ROBINSON YEAR 1976 VOLUME: JAN - JUN 71. m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57	.04	.2		
Co-58	6.84	28.		
Co-60	7.2	29.4		
Cs-134	3.2	13.1		
Cs-137	6.1	25.		
Fe-59				
I-131	.04	.2		
Mn-54	.62	2.5		
Nb-95				
Nb-97				
Sb-124	.24	1.		
Sb-125	.17	.7		
Other				
TOTAL	24.46	100.		

Table 17-h

CATEGORY B

PLANT HADDAM NECK YEAR 1975 VOLUME: JAN - JUN 429. m^3
JUL - DEC 176.4 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	2.3	50.	1.	9.1
Co-60	2.3	50.	9.	81.8
Cs-134			1.	9.1
Cs-137				
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	4.6	100.	11.0	100.

Table 18-a

CATEGORY B

PLANT INDIAN POINT YEAR 1975 VOLUME: JAN - JUN _____ m^3
JUL - DEC 21.2 m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58			.8	22.2
Co-60			.1	3.81
Cs-134			1.	28.5
Cs-137			1.5	2.15
Fe-59				
I-131				
Mn-54			.1	2.15
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL			3.52	99.6

Table 18-b

CATEGORY B

PLANT MAINE YANKEE YEAR 1975 VOLUME: JAN - JUN 71. m^3
JUL - DEC 14.1 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	1.8	20.	5.6	39.2
Co-60	.6	7.	1.0	7.0
Cs-134	2.5	28.	2.1	14.7
Cs-137	4.1	45.	5.6	39.2
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	9.0	100.	14.3	100.

Table 18-c

CATEGORY B

PLANT ROBINSON YEAR 1975 VOLUME: JAN - JUN 52. m^3
JUL - DEC 101. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57	.05	.21	.6	2.35
Co-58	11.0	43.4	12.8	48.3
Co-60			8.5	31.9
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54	3.0	11.9	3.5	13.2
Nb-95	.06	.22	.1	.253
Nb-97				
Sb-124				
Sb-125			.3	1.13
Other	11.2	44.3	.8	2.87
TOTAL	25.3	100.	26.6	100.

Table 18-d

CATEGORY B

PLANT FORT CALHOUN YEAR 1976 VOLUME: JAN - JUN 67.5 m^3
JUL - DEC 101.1 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	6.	57.	1.7	13.
Co-60				
Cs-134	1.3	12.	4.8	36.
Cs-137	2.8	26.	5.9	45.
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other	.5	5.	.8	6.
TOTAL	10.6	100.	13.2	100.

Table 19-a

CATEGORY B

PLANT HADDAM NECK YEAR 1976 VOLUME: JAN - JUN 407.3 m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	.1	10.		
Co-60	.8	80.		
Cs-134				
Cs-137	.05	5.		
Fe-59				
I-131				
Mn-54	.05	5.		
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	1.0	100.		

Table 19-b

CATEGORY B

PLANT INDIAN POINT YEAR 1976 VOLUME: JAN - JUN 106. m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58				
Co-60				
Cs-134	8.5	22.7		
Cs-137	13.7	36.5		
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other*	15.3	40.8		
TOTAL	37.5	100.		

* Includes Mn-54, Co-58 and Co-60

Table 19-c

CATEGORY B

PLANT KEWAUNEE YEAR 1976 VOLUME: JAN - JUN 27.8 m^3
JUL - DEC _____ m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	4.94	65.7		
Co-60				
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other	2.58	34.3		
TOTAL	7.52	100.		

Table 19-d

CATEGORY B

PLANT MAINE YANKEE YEAR 1976 VOLUME: JAN - JUN 34.2 m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	.5	15.		
Co-60	1.1	30.		
Cs-134	.5	15.		
Cs-137	1.4	40.		
Fe-59				
I-131				
Mn-54				
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other				
TOTAL	3.5	100.		

Table 19-e

CATEGORY B

PLANT PRAIRIE ISLAND YEAR 1976 VOLUME: JAN - JUN 69.4 m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	3.6	64.		
Co-60	1.3	22.		
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54	.5	9.		
Nb-95				
Nb-97				
Sb-124				
Sb-125				
Other	.3	5.		
TOTAL	5.7	100.		

Table 19-f

CATEGORY B

PLANT ROBINSON YEAR 1976 VOLUME: JAN - JUN 64.1 m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
Co-57				
Co-58	.3	1.4		
Co-60	15.	61.3		
Cs-134				
Cs-137	5.	20.6		
Fe-59				
I-131				
Mn-54	.5	2.2		
Nb-95	.6	2.5		
Nb-97	.5	2.0		
Sb-124				
Sb-125				
Other	2.5	10.		
TOTAL	24.4	100.		

Table 19-g

CATEGORY A

PLANT COOPER YEAR 1974 VOLUME: JAN - JUN •107. m^3
JUL - DEC 265. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58	.85	24.4	4.4	32.1
Co-60	.06	1.6	.3	2.2
Cr-51	2.58	73.8	9.0	65.7
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other				
TOTAL	3.5	100.	13.7	100.

Table 20-a

CATEGORY A

PLANT HATCH YEAR 1974 VOLUME: JAN - JUN _____ m^3
JUL - DEC 115. m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58			1.2	14.
Co-60				
Cr-51			6.2	75.
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other			.9	11.
TOTAL			8.3	100.

Table 20-b

CATEGORY A

PLANT BRUNSWICK YEAR 1975 VOLUME: JAN - JUN 45. m^3
JUL - DEC _____ m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141	.39	15.9		
Co-58	.74	30.6		
Co-60	.04	1.55		
Cr-51	.95	39.1		
Cs-134				
Cs-137				
Fe-59	.03	1.27		
I-131				
Mn-54	.02	.67		
Na-24				
Nb-95				
Ni-95	<.01	.022		
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	.26	10.89		
TOTAL	2.43	100.		

Table 21-a

CATEGORY A

PLANT COOPER YEAR 1975 VOLUME: JAN - JUN 96.6 m^3
JUL - DEC 121. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58	20.6	25.9	37.8	20.3
Co-60	13.	16.3	39.8	21.4
Cr-51	42.6	53.4	65.3	35.1
Cs-134				
Cs-137				
Fe-59			1.5	.8
I-131				
Mn-54			27.3	14.7
Na-24				
Nb-95	3.4	4.24		
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	.1	.16	14.3	7.7
TOTAL	79.7	100.	186.	100.

Table 21-b

CATEGORY A

PLANT HATCH YEAR 1975 VOLUME: JAN - JUN 204 m^3
JUL - DEC 188. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58	22.1	35.	64.2	31.
Co-60				
Cr-51	28.4	45.	82.8	40.
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65	8.9	14.	55.9	27.
Other	3.8	6.	4.1	2.
TOTAL	63.2	100.	207.	100.

Table 21-c

CATEGORY A

PLANT HUMBOLDT BAY YEAR 1975 VOLUME: JAN - DEC 37.3 m^3

ACTIVITY

ISOTOPE	1975 CURIES	1975 PERCENT		
			CURIES	PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	.4	15.		
Cr-51				
Cs-134	.6	20.		
Cs-137	1.2	40.		
Fe-59				
I-131				
Mn-54	.3	10.		
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	.4	15.		
TOTAL	2.9	100.		

Table 21-d

CATEGORY A

PLANT VERMONT YANKEE YEAR 1975 VOLUME: JAN - JUN 92. m^3
JUL - DEC 56.1 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	1.5	28.7	3.8	28.7
Cr-51	.9	16.6	2.2	16.6
Cs-134				
Cs-137	.8	14.1	1.8	14.1
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65	1.3	24.1	3.2	24.1
Other	.9	16.5	2.2	16.5
TOTAL	5.4	100.	13.1	100.

Table 21-e

CATEGORY A

PLANT COOPER YEAR 1976 VOLUME: JAN - JUN 157. m^3
JUL - DEC 70.5 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58	33.5	13.	6.03	9.8
Co-60	54.4	21.1	12.8	20.9
Cr-51	73.8	28.6	22.5	36.8
Cs-134	5.34	2.1	1.0	1.7
Cs-137	10.4	4.0	1.9	3.2
Fe-59	2.5	1.0	.4	.65
I-131	24.1	9.3	.4	.65
Mn-54	39.5	15.3	11.7	19.1
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	14.5	5.6	4.4	7.2
TOTAL	258.	100.	61.2	100.

Table 22-a

CATEGORY A

PLANT HATCH YEAR 1976 VOLUME: JAN - JUN 167. m^3
JUL - DEC 149. m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58*	{17.9} 44.7	31. {12}	12.6	8.8
Co-60*	{26.8}	{19}	69.5	48.7
Cr-51	57.7	40.		
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65	38.8	27.	50.2	35.2
Other	2.9	2.	10.4	7.3
TOTAL	144.	100.	143.	100

* Estimate based on 40% Co-58 and 60% Co-60

Table 22-b

CATEGORY A

PLANT HUMBOLDT BAY YEAR 1976 VOLUME: JAN - JUN 0.85 m^3
JUL - DEC _____ m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	.02	15.		
Cr-51				
Cs-134	.03	20.		
Cs-137	.05	40.		
Fe-59				
I-131				
Mn-54	.01	10.		
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	.02	15.		
TOTAL	.137	100.		

Table 22-c

CATEGORY A

PLANT MILLSTONE 1 YEAR 1976 VOLUME: JAN - JUN 207. m^3
JUL - DEC 352. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	428.	40.	230.6	38.3
Cr-51				
Cs-134	97.4	9.1	69.2	11.5
Cs-137	179.8	16.8	154.1	25.6
Fe-59				
I-131				
Mn-54	273.9	25.6	103.5	17.2
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	91.	8.5	44.5	7.4
TOTAL	1070.	100.	602.	100.

Table 22-d

CATEGORY A

PLANT NINE MILE POINT YEAR 1976 VOLUME: JAN - JUN 190.1 m^3
JUL - DEC _____ m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	294.8	22.		
Cr-51				
Cs-134	348.4	26.		
Cs-137	629.8	47.		
Fe-59				
I-131	4.3	.32		
Mn-54	41.5	3.1		
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89	2.4	.18		
Sr-90	11.1	.83		
W-187				
Zn-65				
Other	7.6	.57		
TOTAL	1340.	100.		

Table 22-e

CATEGORY A

PLANT VERMONT YANKEE YEAR 1976 VOLUME: JAN - JUN 44. m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	3.4	28.7		
Cr-51	2.0	16.6		
Cs-134				
Cs-137	2.0	16.6		
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65	2.9	24.1		
Other	1.7	14.1		
TOTAL	11.9	100.1		

Table 22-f

CATEGORY B

PLANT COOPER YEAR 1974 VOLUME: JAN - JUN 1.78 m^3
JUL - DEC 3.55 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140		2.6		
Ce-141				
Co-58		25.7		31.8
Co-60				8.22
Cr-51		25.7		49.9
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				8.94
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other				
TOTAL	3.8E-6		7.62E-5	

Table 23-a

CATEGORY B

PLANT HATCH YEAR 1974 VOLUME: JAN - JUN _____ m^3
JUL - DEC 12.8 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60			.0042	14.
Cr-51				
Cs-134			.0225	75.
Cs-137				
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other			.003	11.
TOTAL			.03	100.

Table 23-b

CATEGORY B

PLANT COOPER YEAR 1975 VOLUME: JAN - JUN 52.3 m^3
JUL - DEC 19.7 m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58	.06	24.2	.1	25.7
Co-60	.02	7.25	.05	11.5
Cr-51	.15	61.6	.22	54.9
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95	.02	6.76		
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	<.01	.19	.03	7.9
TOTAL	.247	100.	.401	100.

Table 24-a

CATEGORY B

PLANT HATCH YEAR 1975 VOLUME: JAN - JUN 91.1 m^3
JUL - DEC 94.4 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58	.074	35.	.27	31.
Co-60				
Cr-51	.095	45.	.35	40.
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-95	.0296	14.	.238	27.
Other	.013	6.	.018	2.
TOTAL	.211	100.	.884	100.

Table 24-b

CATEFORY B

PLANT HUMBOLDT BAY YEAR 1975 VOLUME: JAN - JUN 89.3 m^3
JUL - DEC _____ m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	12.1	30.		
Cr-51				
Cs-134	4.	10.		
Cs-137	6.	15.		
Fe-59				
I-131				
Mn-54	12.1	30.		
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	6.	15.		
TOTAL	40.2	100.		

Table 24-c

CATEGORY B

PLANT VERMONT YANKEE YEAR 1975 VOLUME: JAN - JUN 21.4 m^3
JUL - DEC 139. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	.3	28.7	.8	28.7
Cr-51	.2	16.6	.5	16.6
Cs-134				
Cs-137	.2	14.1	.4	14.1
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65	.3	24.1	.7	24.1
Other	.2	16.5	.5	16.5
TOTAL	1.2	100.	2.9	100.

Table 24-d

CATEGORY B

PLANT COOPER YEAR 1976 VOLUME: JAN - JUN 31.4 m^3
JUL - DEC 42.5 m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58	.03	22.6	.15	13.
Co-60	.02	15.1	.24	21.1
Cr-51	.06	45.3	.32	28.6
Cs-134			.02	2.07
Cs-137			.05	4.02
Fe-59			.01	.95
I-131			.10	9.35
Mn-54	.01	7.55	.17	15.3
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	.01	9.45	.06	5.61
TOTAL	.132	100.	1.12	100.

Table 25-a

CATEGORY B

PLANT HATCH YEAR 1976 VOLUME: JAN - JUN 61.6 m^3
JUL - DEC 33.5 m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58*	{.14 .22} .364	31. {12. 19.}	.0383	4.1
Co-60*				
Cr-51	.47	40.	.455	48.7
Cs-134				
Cs-137				
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65	.318	27.	.329	35.2
Other	.023	2.	.111	12.
TOTAL	1.17	100.	.933	100.

*Estimate based on 40% Co-58 and 60% Co-60

Table 25-b

CATEGORY B

PLANT HUMBOLDT BAY YEAR 1976 VOLUME: JAN - JUN 44.8 m^3
JUL - DEC _____ m^3

ACTIVITY

ISOTOPE	JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	.85	30.		
Cr-51				
Cs-134	.28	10.		
Cs-137	.42	15.		
Fe-59				
I-131				
Mn-54	.85	30.		
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	.42	15.		
TOTAL	2.82	100.		

Table 25-c

CATEGORY B

PLANT MILLSTONE 1 YEAR 1976 VOLUME: JAN - JUN 291. m^3
JUL - DEC 478. m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	13.5	72.	4.19	72.
Cr-51				
Cs-134				
Cs-137	1.7	9.	.52	9.
Fe-59				
I-131				
Mn-54	2.4	13.	.76	13.
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65				
Other	1.1	6.	.35	6.
TOTAL	18.8	100.	5.82	100.

Table 25-d

CATEGORY B

PLANT VERMONT YANKEE YEAR 1976 VOLUME: JAN - JUN 32. m^3
JUL - DEC _____ m^3

ISOTOPE	ACTIVITY JAN - JUN CURIES	JAN - JUN PERCENT	JUL - DEC CURIES	JUL - DEC PERCENT
BaLa-140				
Ce-141				
Co-58				
Co-60	.53	28.7		
Cr-51	.30	16.6		
Cs-134				
Cs-137	.30	16.5		
Fe-59				
I-131				
Mn-54				
Na-24				
Nb-95				
Ni-95				
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65	.44	24.1		
Other	.26	14.1		
TOTAL	1.83	100.		

Table 25-e

CATEGORY A

PLANT PRESSURIZED WATER REACTORS VOLUME: 1975 604.5 m^3
1976 1245.4 m^3

ACTIVITY

ISOTOPE	1975 CURIES	1975 PERCENT	1976 CURIES	1976 PERCENT
Co-57	.06	<.01	.04	<.01
Co-58	887.56	21.8	152.5	9.4
Co-60	1112.08	27.3	585.64	35.9
Cs-134	776.63*	19.6	254.44	15.6
Cs-137	1215. *	30.6	434.45	26.6
Fe-59			.02	<.01
I-131	.05	<.01	.68	<.01
Mn-54	28.275	.7	33.97	2.1
Nb-95	.04	<.01		
Nb-97	.97	<.01		
Sb-124	.52	<.01	.24	<.01
Sb-125				<.01
Other	.36	<.01	167.75	10.3
TOTAL	4075.	100.	1630.04	>99.9

* Includes 54 curies reported as combined. 22 curies were assumed to be Cs-134 and 32 curies as Cs-137.

CATEGORY B

PLANT PRESSURIZED WATER REACTORS

VOLUME: 1975 812.7 m^3
1976 877.4 m^3

ACTIVITY

ISOTOPE	1975 CURIES	1975 PERCENT	1976 CURIES	1976 PERCENT
Co-57	.6	.9		
Co-58	24.3	35.2	17.1	16.5
Co-60	21.5	31.2	18.2	17.6
Cs-134	6.1	8.8	15.1	14.6
Cs-137	11.7	17.0	28.9	27.9
Fe-59				
I-131				
Mn-54	3.6	5.2	1.1	1.1
Nb-95	.1	.1	.6	.6
Nb-97			.5	.5
Sb-124				
Sb-125	.3	.4		
Other	.8	1.2	22.0	21.2
TOTAL	69.	100.	103.5	100.

Table 26-b

CATEGORY A

PLANT BOILING WATER REACTORS VOLUME: 1974 487. m^3
1975 840. m^3

ACTIVITY

ISOTOPE	1974 CURIES	1974 PERCENT	1975 CURIES	1975 PERCENT
BaLa-140				
Ce-141			.4	.07
Co-58	6.4	25.	145.5	26.0
Co-60	.4	2.	58.5	10.4
Cr-51	17.8	70.	223.4	39.9
Cs-134			.6	.1
Cs-137			3.8	.7
Fe-59			1.5	.3
I-131				
Mn-54			27.6	4.9
Na-24				
Nb-95			3.4	.6
Ni-95			trace <.001	<.01
Sb-124				
Sr-89				
Sr-90				
W-187				
Zn-65			69.4	12.4
Other	.9	3.	26.0	4.9
TOTAL	25.5	100.	560.	99.97

Table 27-a

CATEGORY A

PLANT BOILING WATER REACTORS VOLUME 1976 1337 m^3

ACTIVITY

ISOTOPE	1976 CURIES	PERCENT
BaLa-140		
Ce-141		
Co-58	57.4	1.6
Co-60	1063.4	29.3
Cr-51	225.5	6.2
Cs-134	521.4	14.4
Cs-137	978.0	26.9
Fe-59	2.9	.08
I-131	28.8	.8
Mn-54	470.1	13.0
Na-24		
Nb-95		
Ni-95		
Sb-124		
Sr-89	2.4	<.01
Sr-90	11.1	.3
W-187		
Zn-65	91.9	2.5
Other	177.0	4.9
TOTAL	3630.	99.99

CATEGORY B

PLANT BOILING WATER REACTORS VOLUME: 1975 507. m^3
1976 1015. m^3

ACTIVITY

ISOTOPE	1975 CURIES	1975 PERCENT	1976 CURIES	1976 PERCENT
BaLa-140				
Ce-141				
Co-58	.5	1.1	.36	1.1
Co-60	13.3	28.9	19.6	60.1
Cr-51	1.5	3.3	1.6	4.9
Cs-134	4.0	8.7	.3	.9
Cs-137	6.6	14.3	3.0	9.2
Fe-59			.01	.03
I-131			.1	.3
Mn-54	12.1	26.3	4.2	12.9
Na-24				
Nb-95	.02	.04		
Ni-95				
Sb-124				
Sr-89				
Sr-90				
Zn-65	1.0	2.2	1.09	3.3
Zn-95	.27	.6		
Other	6.73	14.6	2.33	7.2
TOTAL	46.0	100.	32.6	99.93

Table 27-c

Relative Composition of Low-Level Solid Waste from LWRs

	Category A (filter sludge, resin and evap. bott.)		Category B (dry compress., contam. equip.)	
	PWR	BWR	PWR	BWR
Ci/plant-yr (%)	670 (96)	400 (98)	26 (4)	10 (2)
m^3/plant-yr (%)	275 (54)	250 (57)	230 (46)	190 (43)
% by nuclide				
Co-58	18	5	26	1
Co-60	30	27	20	42
Cs-134	18	12	11	5
Cs-137	30	23	20	12
Mn-54	1	12	4	21
Other	3	21	19	19

Table 28

Composition of Solid Waste by Nuclide - NRC

Nuclide %	Filter Sludge/Spent Resin BWR[1]	PWR[2]	Evaporator Bottoms BWR[3]	PWR[2]
Co-58	-		1	22
Co-60	40	39	15	17
Cs-134	8	18	28	20
Cs-137	30	25	49	18
Mn-54	22	3	2	6
I-131	-	-	1	9

[1] Nine Mile Point Unit 1, January - December 1974

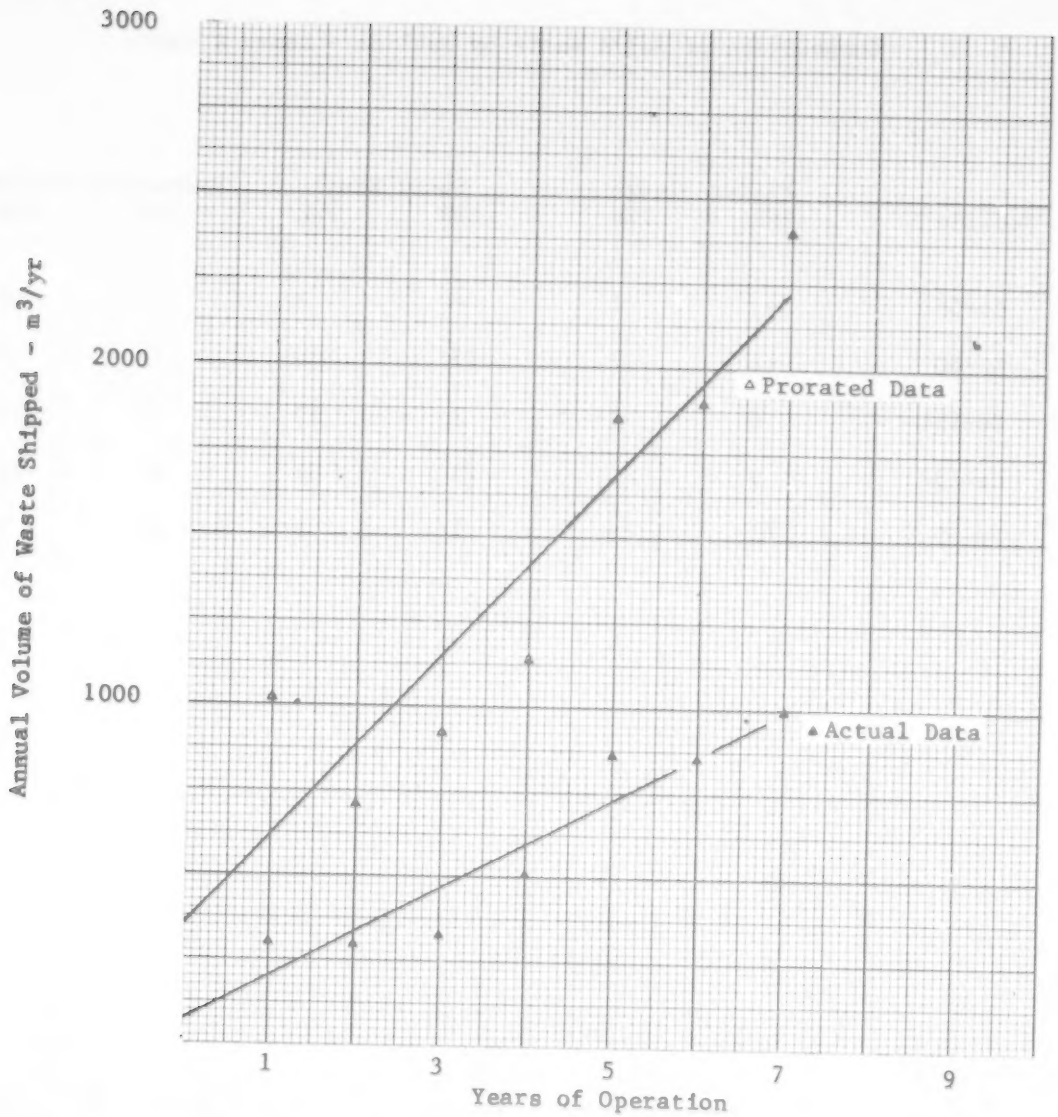
[2] H. B. Robinson Unit 2, January - June 1975

[3] Nine Mile Point Unitl, January - June 1975

Composition of Solid Waste by Nuclide - Dames & Moore

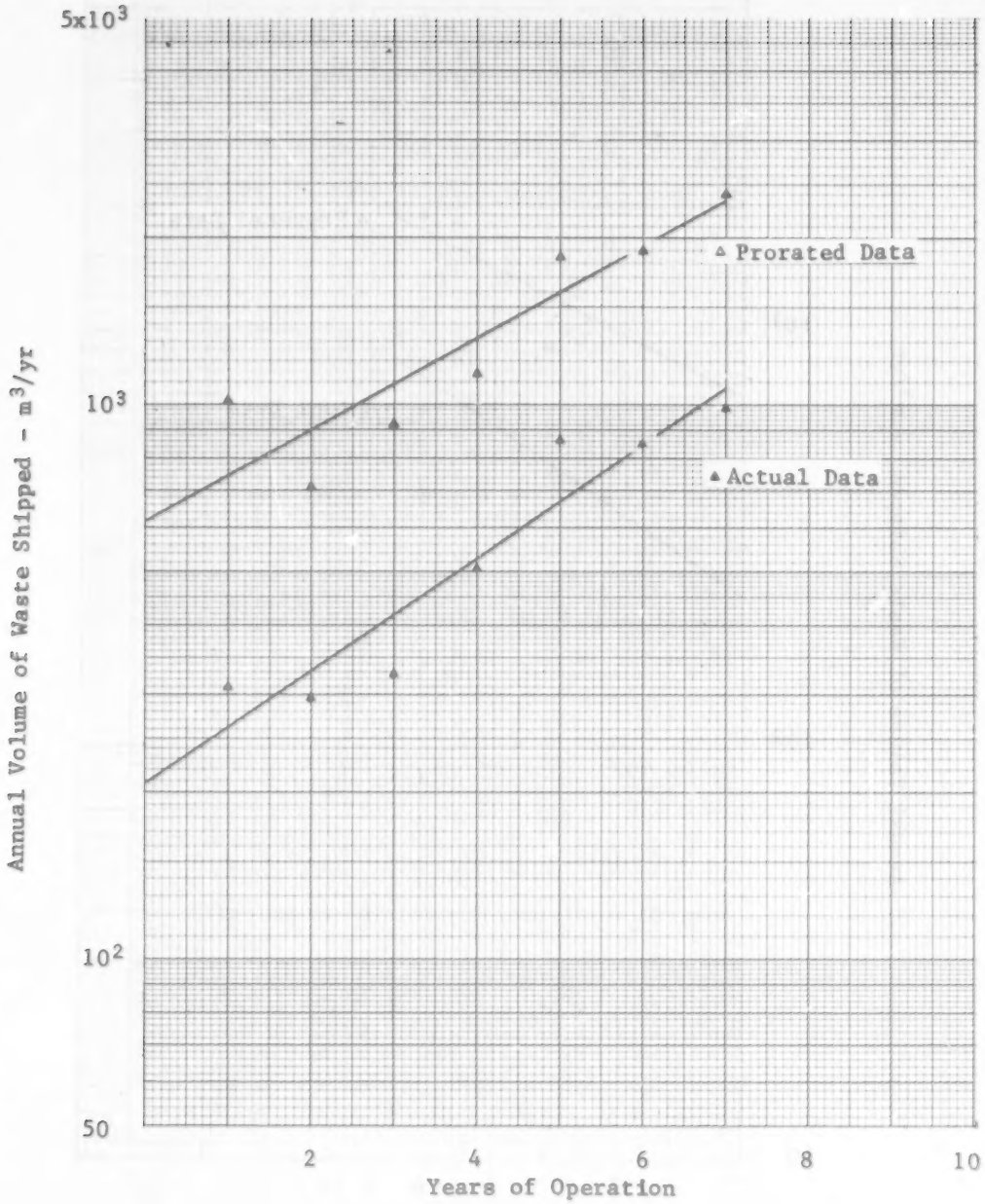
Nuclide %	Filter Sludge		Spent Resin		Evaporator Bottoms	
	BWR	PWR	BWR	PWR	BWR	PWR
Co-58	-	1	-	1	-	10
Co-60	12	17	15	5	11	6
Cs-134	6	1	7	30	20	11
Cs-137	9	1	73	53	27	30
Fe-55	61	63	1	3	34	1

Table 30



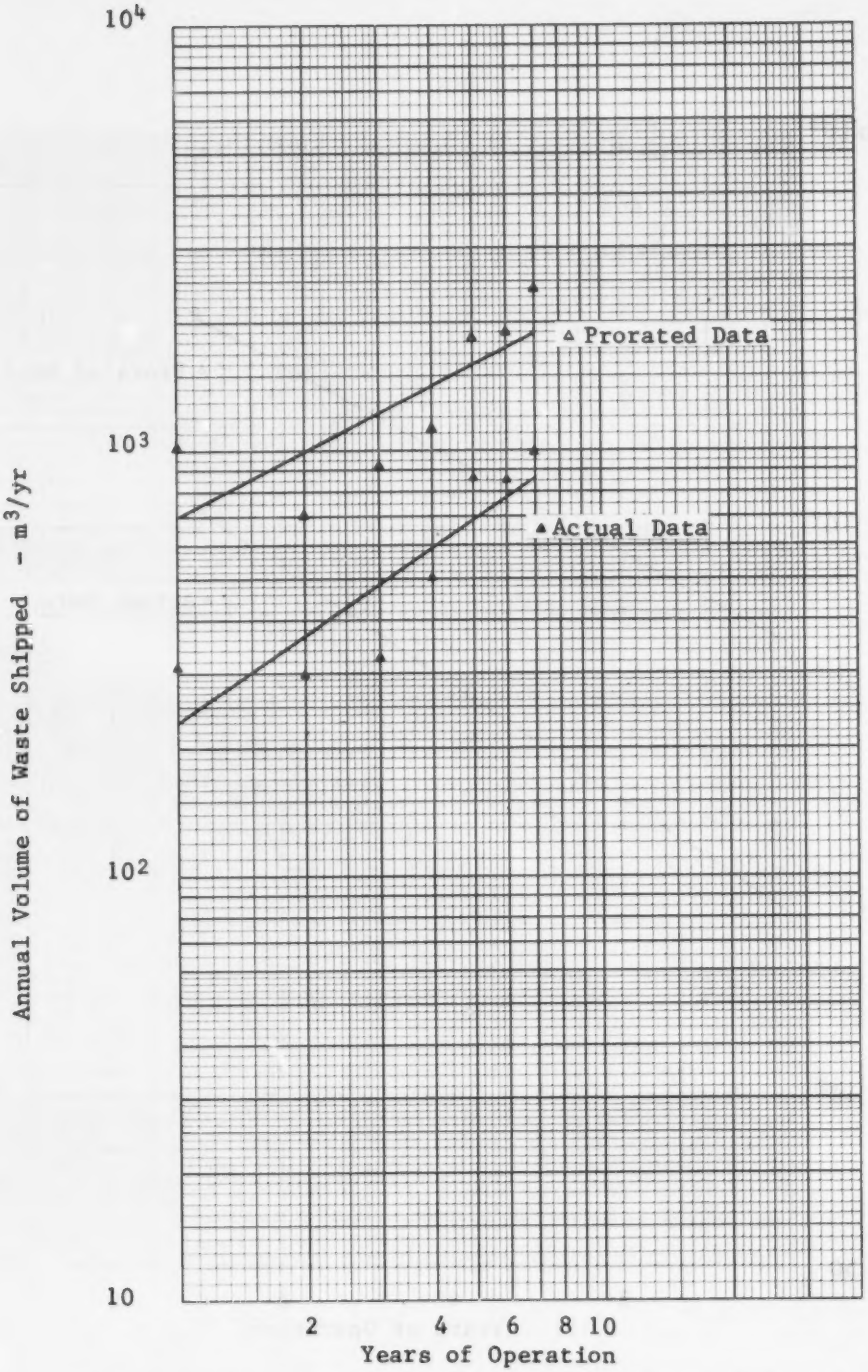
Annual Volume of Waste Shipped vs. Number of Years of Operation
Boiling Water Reactors

Figure 1



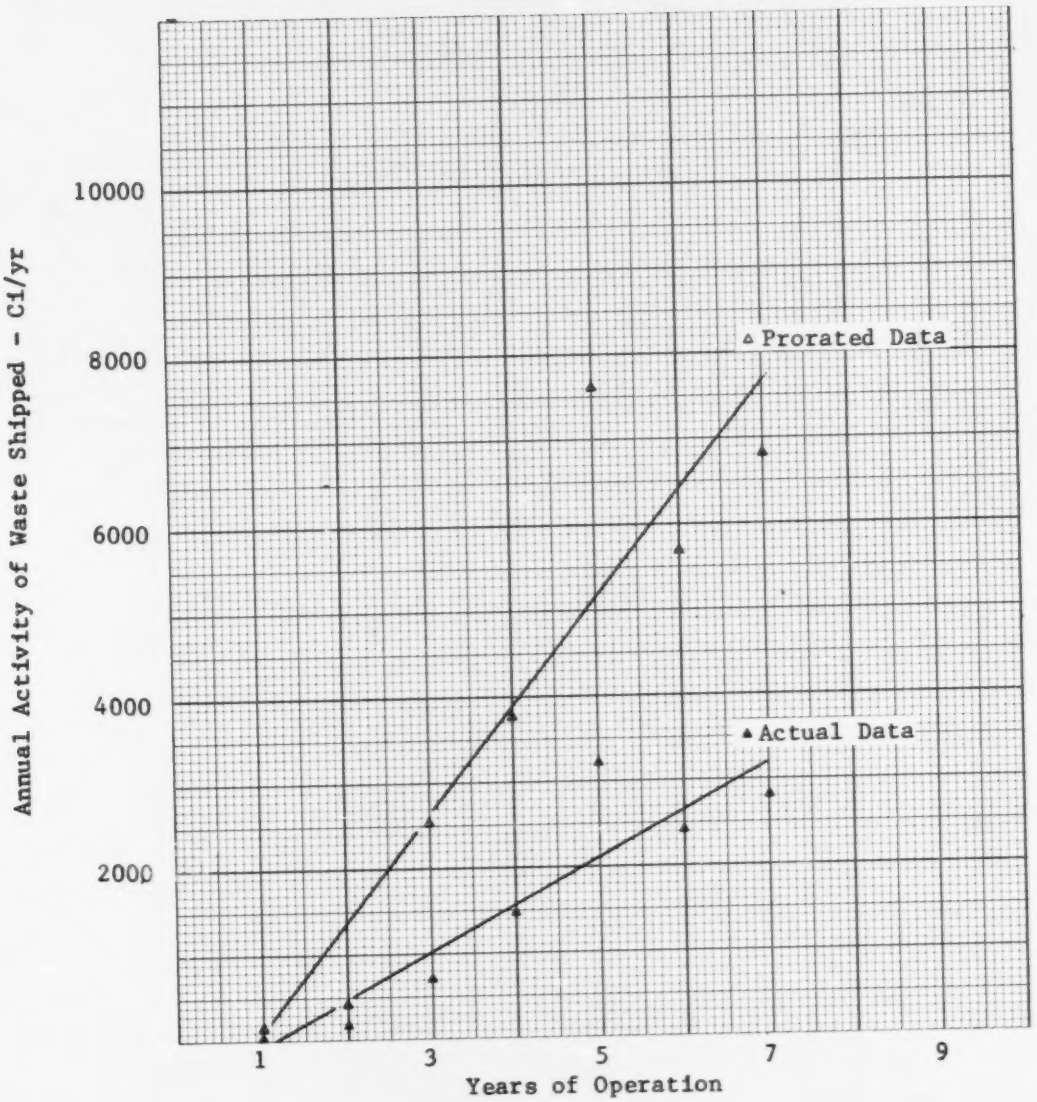
Annual Volume of Waste Shipped vs. Number of Years of Operation
Boiling Water Reactors

Figure 2



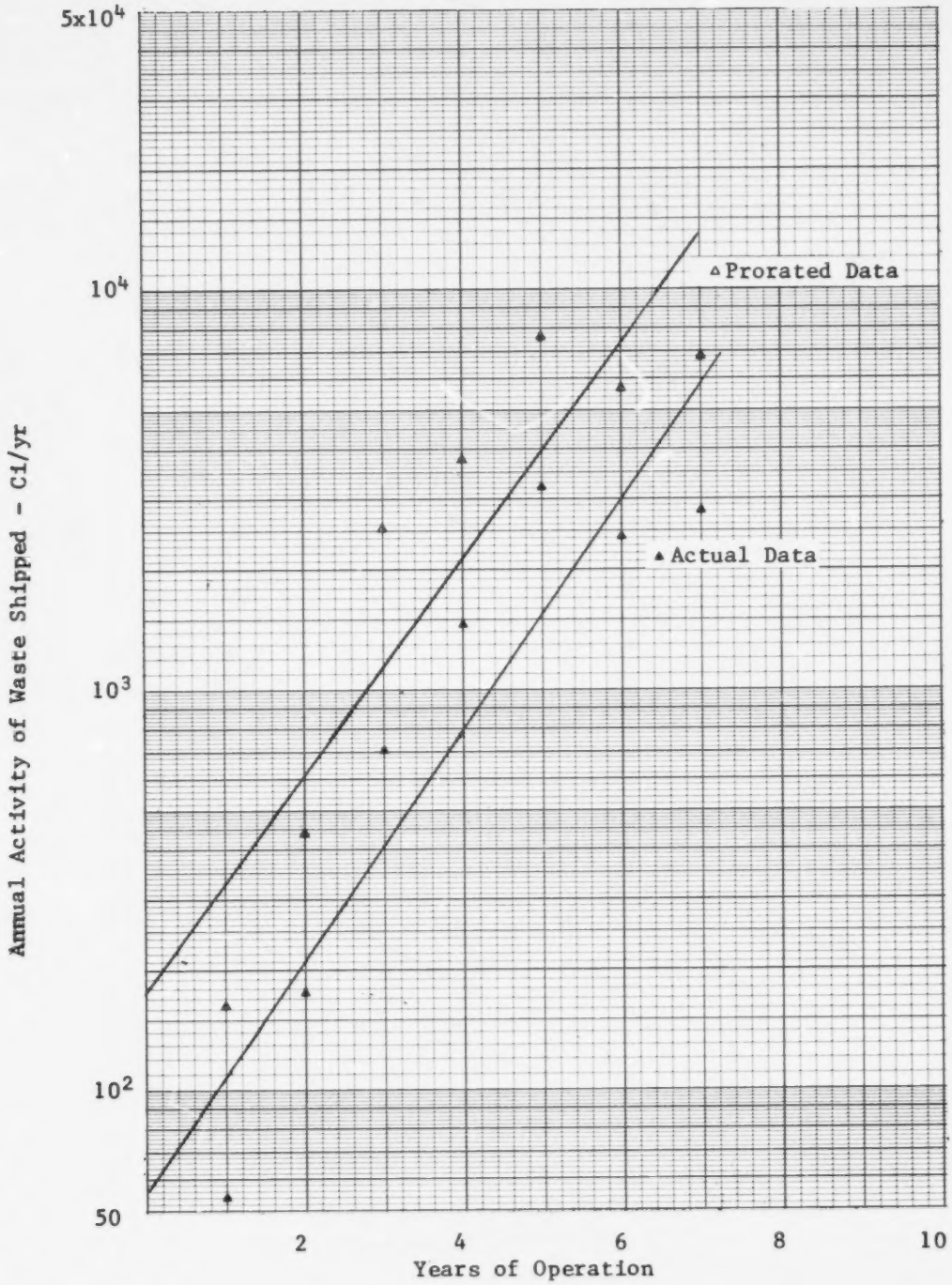
Annual Volume of Waste Shipped vs. Number of Years of Operation
Boiling Water Reactors

Figure 3



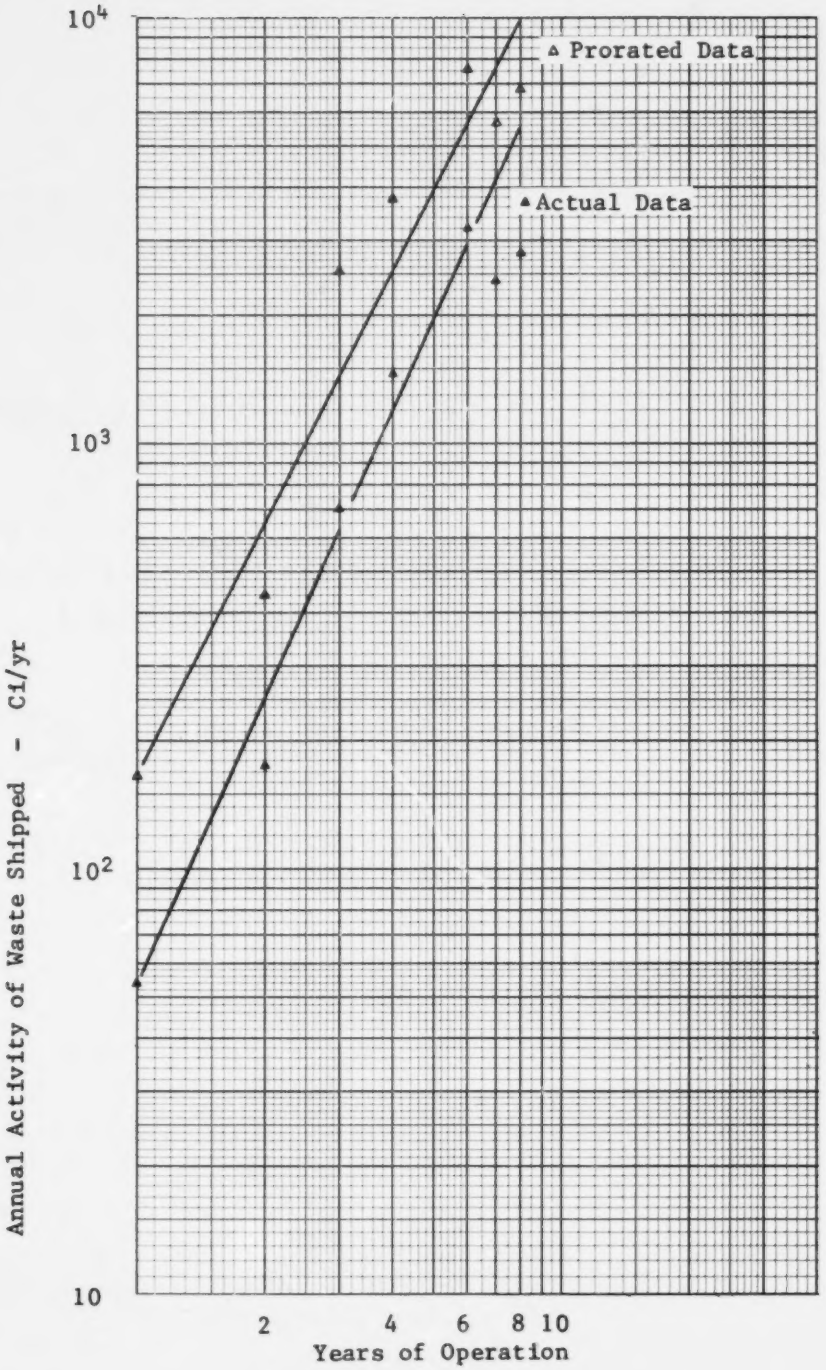
Annual Activity of Waste Shipped vs. Number of Years of Operation
Boiling Water Reactors

Figure 4



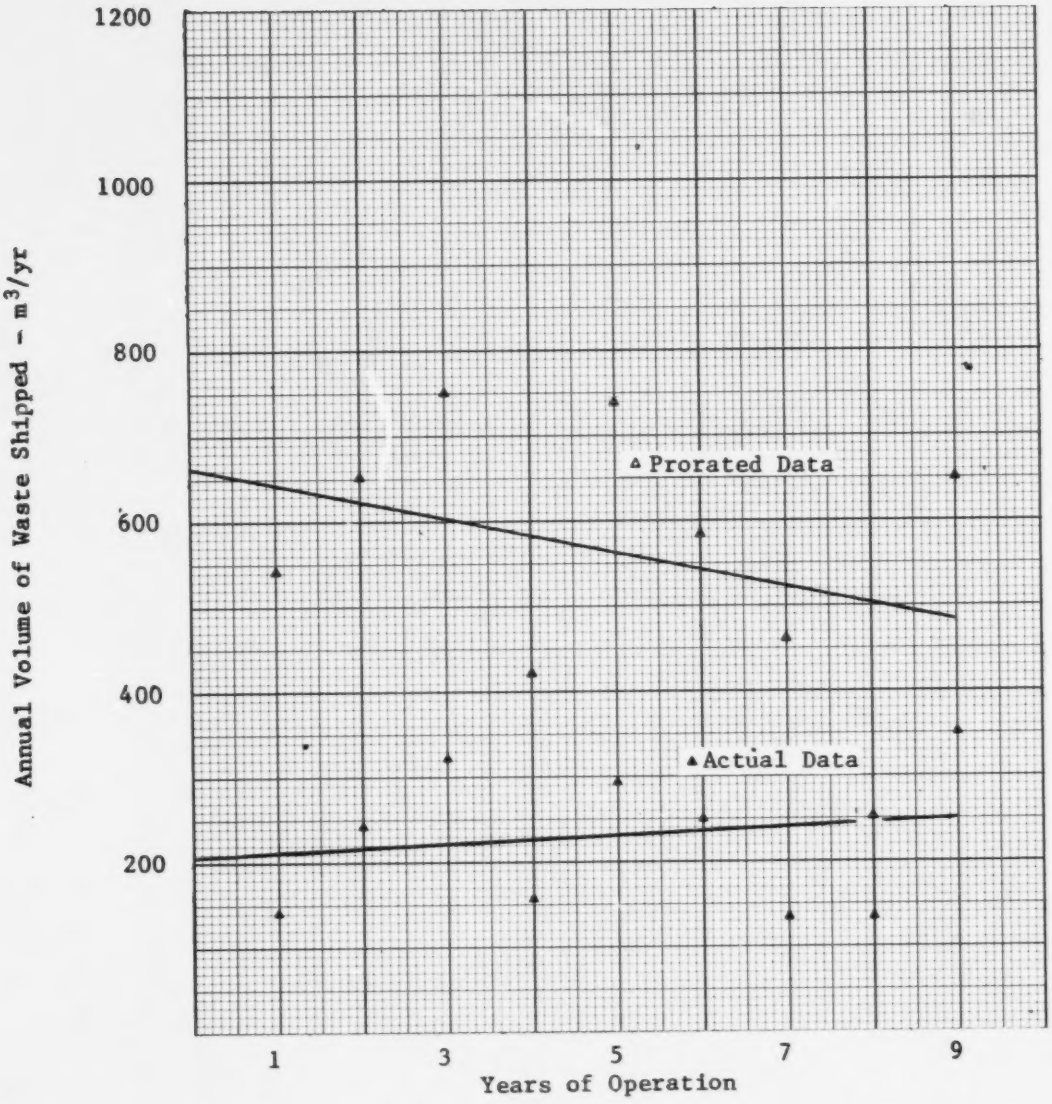
Annual Activity of Waste Shipped vs. Number of Years of Operation
Boiling Water Reactors

Figure 5



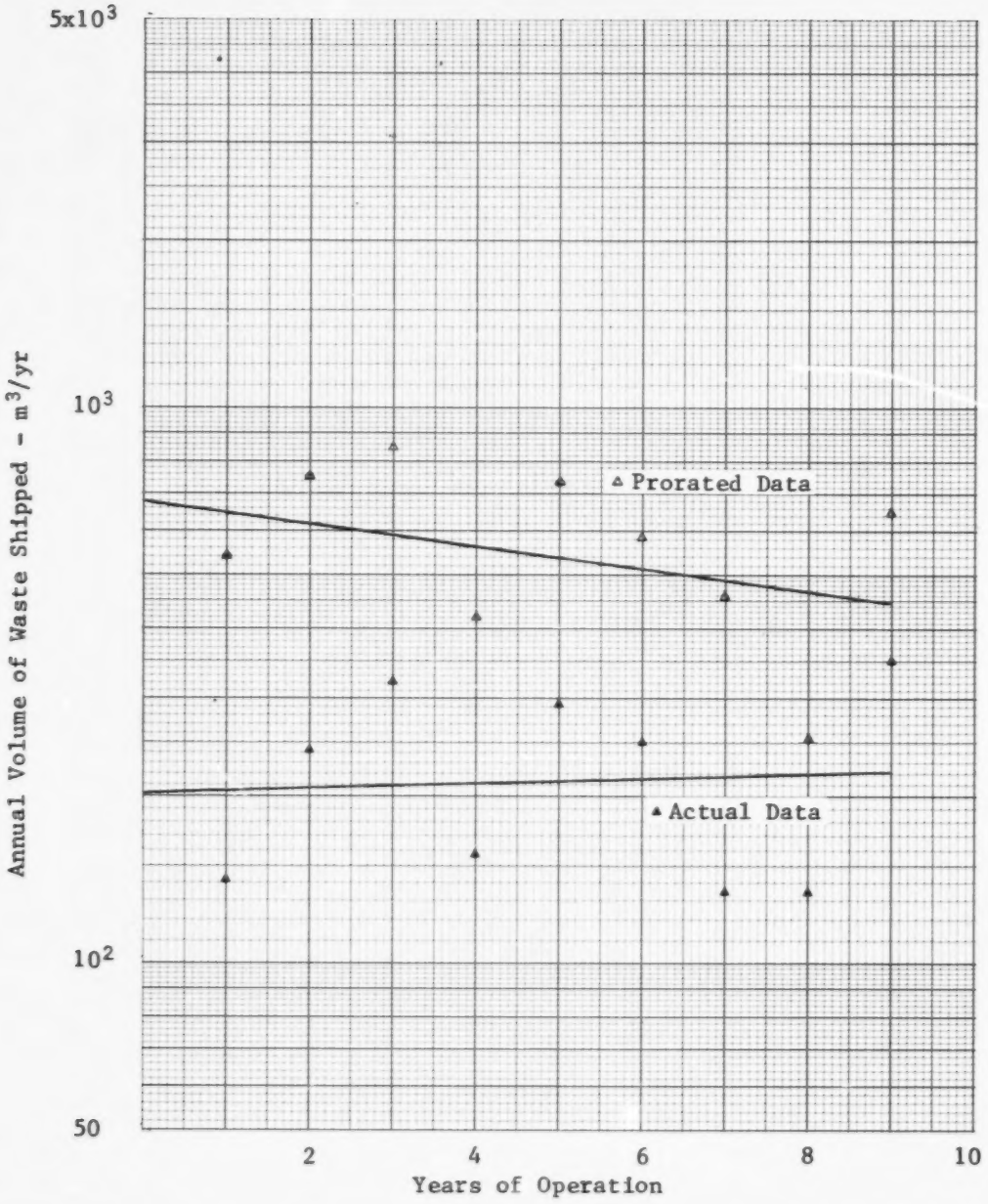
Annual Activity of Waste Shipped vs. Number of Years of Operation
Boiling Water Reactors

Figure 6



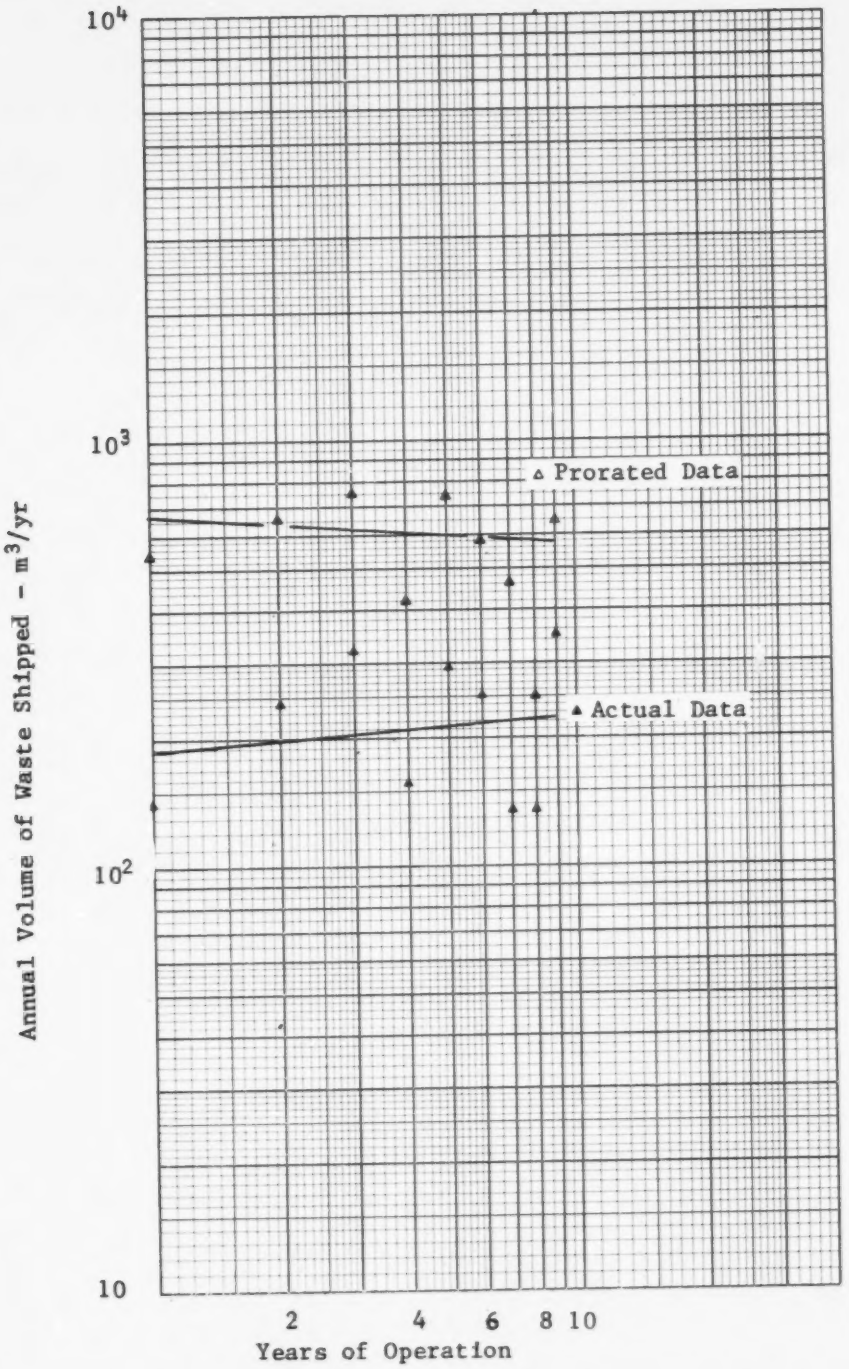
Annual Volume of Waste Shipped vs. Number of Years of Operation
Pressurized Water Reactors

Figure 7



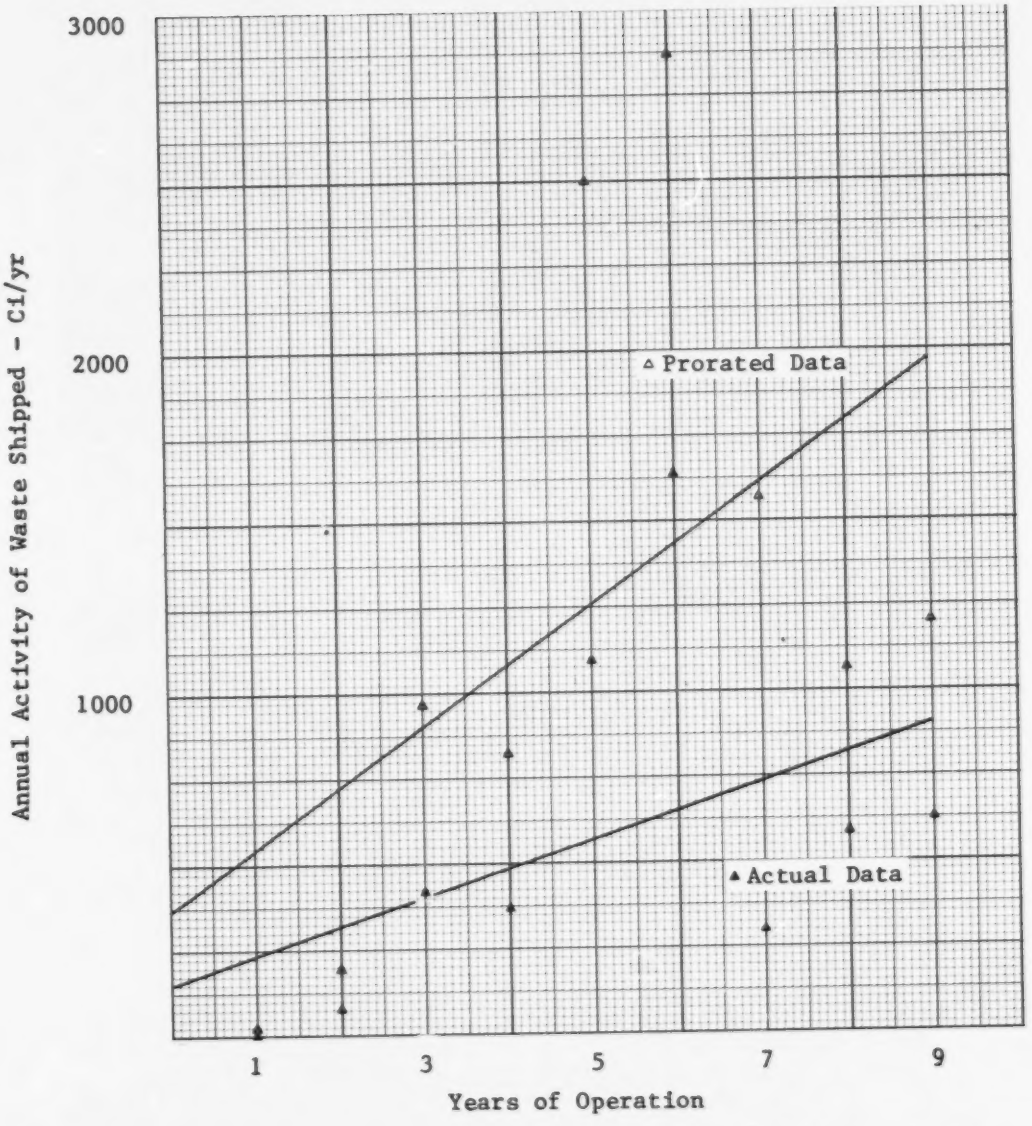
Annual Volume of Waste Shipped vs. Number of Years of Operation
Pressurized Water Reactors

Figure 8



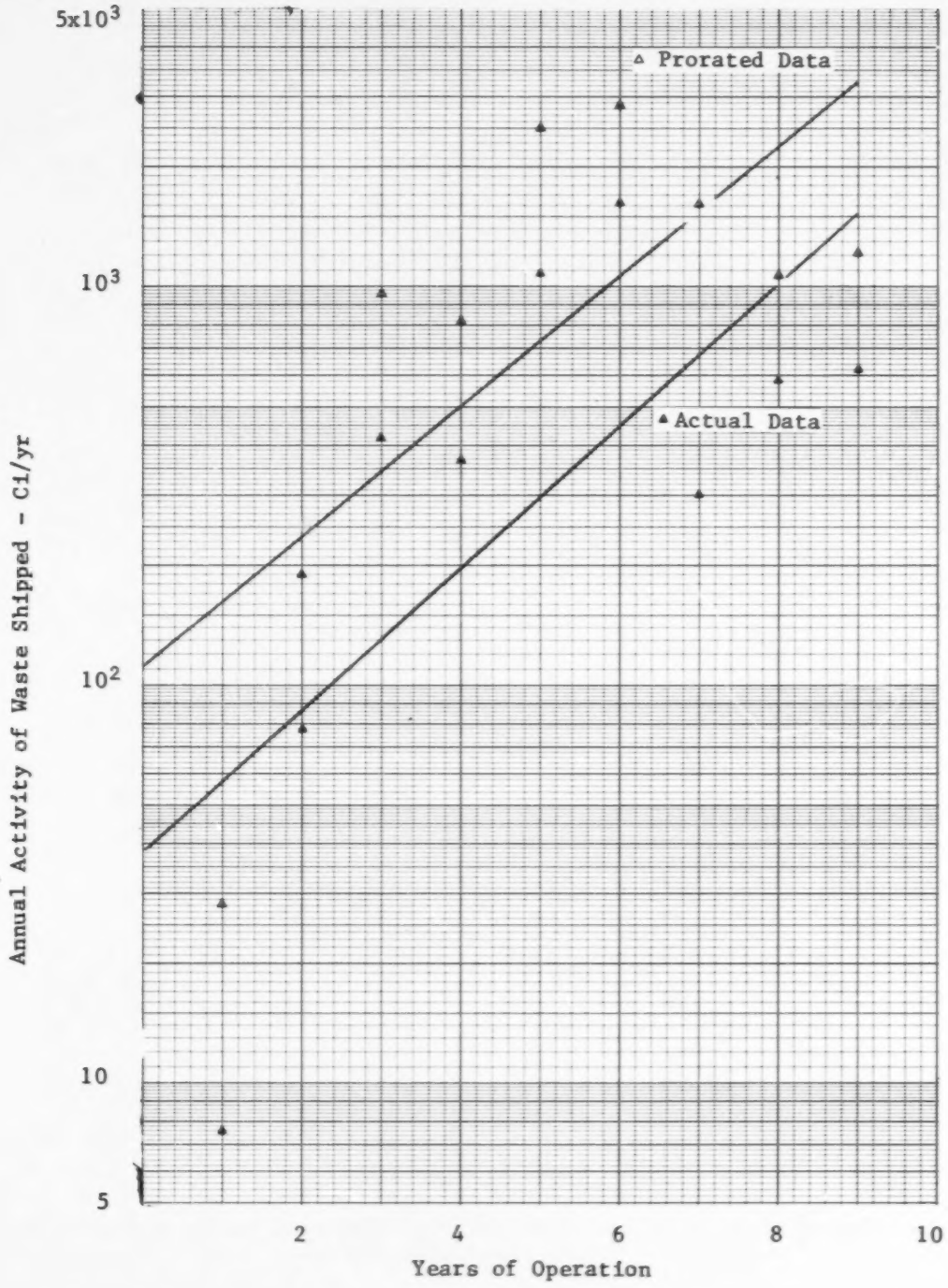
Annual Volume of Waste Shipped vs. Number of Years of Operation
Pressurized Water Reactors

Figure 9



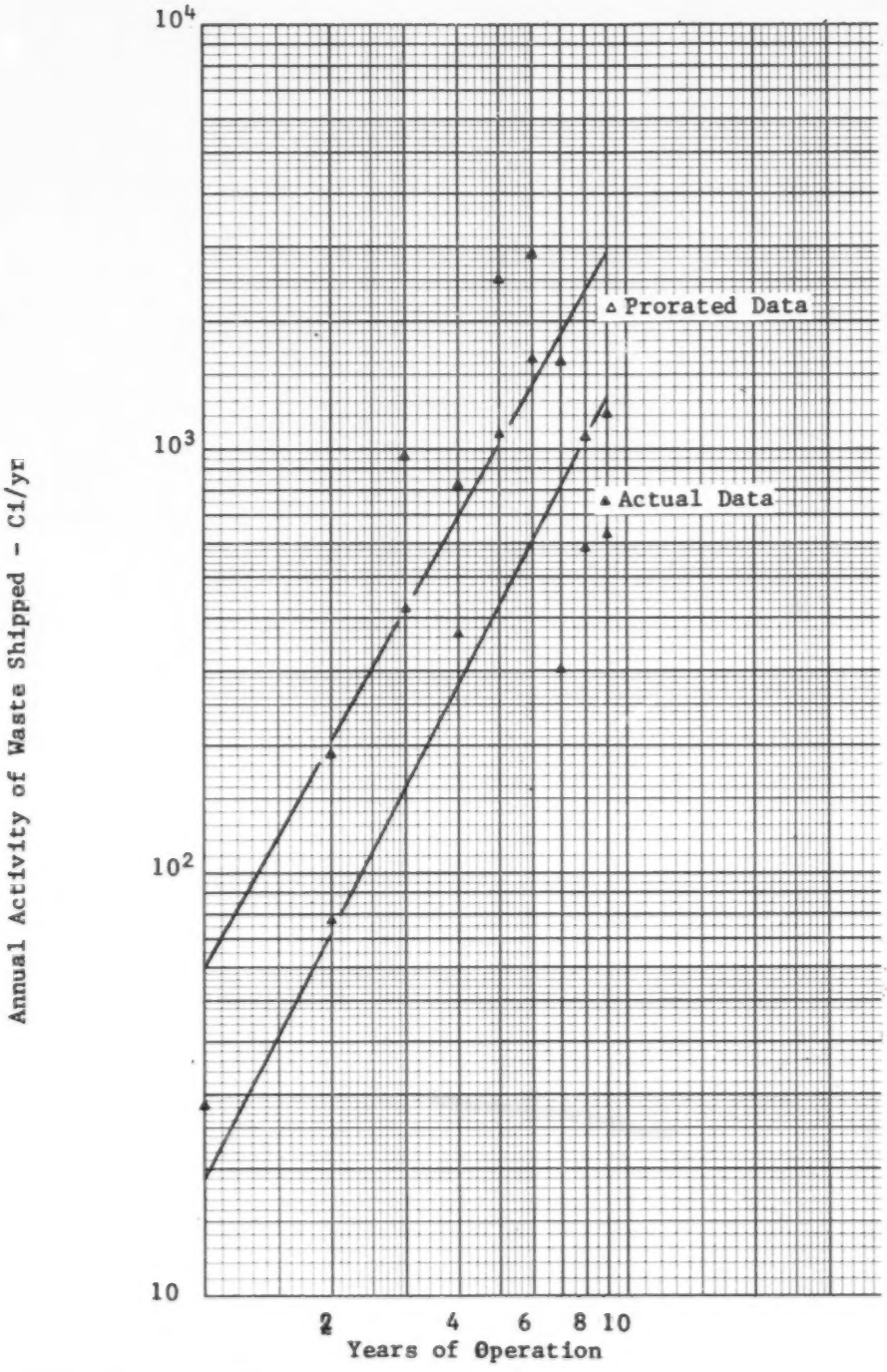
Annual Activity of Waste Shipped vs. Number of Years of Operation
Pressurized Water Reactors

Figure 10



Annual Activity of Waste Shipped vs. Number of Years of Operation
Pressurized Water Reactors

Figure 11



Annual Activity of Waste Shipped vs. Number of Years of Operation
Pressurized Water Reactors

Figure 12

*U.S. GOVERNMENT PRINTING OFFICE : 1977 0-260-880/111

References

Be-77 Bell M. J., 1977, "Sources of Reactor Wastes, Their Characterization and Amounts", Radwaste Management Workshop, sponsered by ORNL.

Cr-69 CRC Handbook of Tables for Probability and Statistics, Second Edition 1969, pg 390, (Edition by Beyer, W.) published by The Chemical Rubber Co.

Da-76 Dames & Moore, 1976, "Preliminary Draft - Final Report Study to Characterize Low-Level Radioactive Wastes Generated by Light Water Reactors", prepared for the New York State ERDA.

Ma-75 Mann B. J., Goldberg S. M., Hendricks W. D., 1975, "Low-Level Solid Radioactive Waste in the Nuclear Fuel Cycle", in Trans. Am. Nuc. Soc., Winter Meeting.

Mu-76 Mullarkey T. B., Jentz T. L., Connelly J. M., Kane J. P., 1976, "A Survey and Evaluation of Handling and Disposing of Solid Low-Level Nuclear Fuel Cycle Wastes", AIF/NESP-008ES.